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SUPPLEMENT TO APRIL 1974
TASK IV FINAL REPORT

(15) DAAG39-73-C-0248

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USASIGS

INTEGRATED TACTICAL COMMUNICATIONS SYSTEM

TASK IV

REVISED MRTF COMMUNICATIONS CONCEPTS

FINAL REPORT

DA Contract DAAG39-73-C-0248

OR 12,821-5 DECEMBER 1974

Prepared for:

Commandant, USASIGS

ATSN-CTD-CS - S

Fort Gordon, Georgia 30905

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SUPPLEMENT TO APRIL 1974
TASK IV FINAL REPORT

ABSTRACT

MRTF Concepts ALPHA, BRAVO, and CHARLIE have been revised to:

- Define the baseline communications Concept ALPHA as current TOE's and approved programmed acquisitions.

- Reflect an improved communications support capability of Concept BRAVO and CHARLIE through the logical introduction of future C-E equipments. BRAVO introduces improved HICAP ATACS, TACSATCOM and SINCGARS. CHARLIE introduces MARTS in the Brigades and hybrid TRITAC in the Corps Sector.

Concept ECHO, which replaces the Concept DELTA previously described in the Task IV report, identifies a communications system designed to idealize the mix of communications options so as to achieve maximum overall cost effectivenss of the total system. Concept ECHO:

- Introduces single channel and multichannel Demand Assigned Time Division Multiple Access (DA TDMA) TACSATCOM.

- Expands employment of demand assigned mobile access radio telephone in division and introduces this technique into selected elements of the echelons above the division (EAD).

- Introduces the unified theater army concept.

The DA TDMA TACSATCOM single and multichannel systems replace the Preassigned Frequency Division Multiple Access (PA FDMA) TACSATCOM introduced in Concept BRAVO. The DA TDMA capability is introduced at all echelons where established requirements justify taking advantage of the significant capacity increase afforded by this new technique. The Mobile Automatic Radio Telephone System, (MARTS) which was introduced in Concept CHARLIE for separate and divisional Brigades, is expanded to suitable applications throughout the Division and selected elements of EAD, and appropriate tradeoffs with existing systems will be accomplished to take advantage of the flexibility and mobility afforded by MARTS, as well as the anticipated manpower savings.

FOREWORD

This Task IV report has been prepared by MMC for the Commandant, USASIGS, in accordance with the modified provisions of Contract No. DAAG 39-73-C-0248. Concepts ALPHA, BRAVO, CHARLIE, and DELTA, which were originally developed by the government during Phase I of the INTACS study effort, were refined and described in detail in the Task IV Refined Alternative Mid-Range Time Frame (MRTF) Communications Concept Final Report (April 1974). The contract has since been modified to provide for definition by the contractor of a new Concept ECHO which is substituted for the original Concept DELTA as the fourth MRTF concept. Additional guidance has resulted in the revision of Concept ALPHA to reflect a baseline concept based on current TOE's and approved programmed acquisitions. Concepts BRAVO and CHARLIE are revised to reflect progressive communications support improvements over Concept ALPHA. These revisions are in terms of C-E materiel assignments by concept, and do not alter the INTACS guidelines on operational management responsibilities.

These improvements reflect a transition from the analog distribution, digital transmission system of today to a nearly all digital system of the future. As a result, TRITAC-developed equipment will be introduced to the fullest extent possible. SINCTRAC equipment will be introduced to fill voids in those areas not covered by TRITAC equipment.

Concept ECHO exploits to the maximum justifiable extent the techniques of DA TDMA and MARTS; subsequent analysis of the concept during Task V will satisfy the Army requirement for a Cost and Operational Effectiveness Analysis of both techniques. It is known that the employment of MARTS and DA TDMA TACSATCOM offers advantages in increased flexibility and mobility, as well as potential personnel savings. Concept ECHO has only 21,000 signal personnel as compared to the 31,000 in Concept ALPHA, thus resulting in a net saving of 10,000 signal personnel. These figures are based upon the INTACS force model. (Refer to paragraph 3.3.3 of this report.) Based on an FY 74 USASIGS enrollment of over 17,000 officers and EM, an annual decrease of approximately 5,000 is estimated. Based upon a comparison of one Division multichannel system in Concept ECHO vs ALPHA, it is estimated that a 1/3 reduction in weight, or 20 tons, is achieved by the employment of DA TDMA TACSAT and MARTS to replace LOS multichannel, manual switching, and wire.

There are, of course, accompanying disadvantages, particularly for TACSAT, of space segment cost and possible vulnerability which must be evaluated carefully during the Task V comparative analysis. The ideal mix of these new techniques and existing systems to bring about the most effective overall tactical communications system, while maintaining minimum vulnerability, will be a specific product of this analysis. The originally defined concepts were constrained by specifically limited deployments of innovative techniques. Concept ECHO provides for idealized utilization of both MARTS and DA TDMA TACSAT, constrained only by cost/effective employment in competition with existing techniques and equipments. The Task V analysis will evaluate candidate Concept ECHO against the other alternative candidates in accordance with the approved Task III methodology. The evaluation, comparison, sensitivity, trade-off, and ranking analyses will result in a recommended preferred system comprised of the most cost effective mix of all the various communications options.

CONTENTS

ILLUSTRATIONS

TABLES

1.0 INTRODUCTION

The MRTF Concepts ALPHA (baseline concept), BRAVO, and CHARLIE as described in the Final Task IV report (April 1974) have been revised to reflect an improved communications capability with each succeeding concept. An updated summary management reponsibilities table has been incorporated for clarification purposes and reflects INTACS organizational management responsibilities by concept. Two summary tables depict revisions in communication functional areas and C-E equipments by functional areas for each concept. The summary functional area tables identify current and future C-E equipments to be used in each concept. Summary diagrams illustrate the baseline concept multichannel and single channel communications support facilities, and indicate the multichannel and single channel changes introduced by the succeeding BRAVO and CHARLIE concepts.

The Force Model and associated User Communications Requirements are presently being modified by the Army. The results of these revisions will be used in Task V for the configuration, sizing and evaluation of each concepts communications supporting system.

The description of Concept ECHO presented herein contains a summary section which identifies multichannel and single channel equipments introduced in this concept, plus a summary of the rationale used for employing Demand Assigned Time Division Multiple Access (DA TDMA) TACSAT and MARTS communication facilities while indicating the potential reduction in material and personnel afforded by the application of the two communications capabilities. Concept ECHO is further described in terms of system functions, equipment, doctrine, and signal organizations for each echelon. Function and equipment assets are described for each of the eleven functional areas.

Three appendices of Task IV have been expanded and provide related technology and equipment data on DA TDMA, MARTS, CE Assets, and an illustration of Concept ECHO from Company to Theater Echelon.

The following steps were performed in the definition and refinement of Concept ECHO:

- The MARTS and TACSAT equipment concepts were defined.
- Rationales were developed for the employment of MARTS and DA TDMA at all echelons.
- MARTS and DA TDMA candidate user units were identified at all echelons based on the rationales.
- Potential reductions in equipments and personnel were estimated based on preliminary Task V information.

Each new system or improvement must work properly with its predecessors, and the equipments on hand, as well as planned acquisitions, must be taken into account.

The four concepts differ greatly in this respect with ALPHA making the most use of inventory and ECHO the least. In particular, there is a transition to ATACS improved equipment in BRAVO. Then there is a progressive displacement of ATACS equipments by TRITAC equipments in CHARLIE and ECHO. Task V, Candidates Design and Evaluation, will show which candidate is most cost-effective. The recommended preferred system, which most probably will be a mix of candidates, will include inventory items and recommended acquisitions. The anticipated preferred system will have a smooth transition toward the digital capability both from the fiscal and the technical viewpoints. The formulation of a smooth transition plan, which will be put in final form in Task VII, is one of the most important aspects of this study.

2.0 MRTF CONCEPT SUMMARY

2.1 SUMMARY OF INTACS MANAGEMENT RESPONSIBILITIES

Baseline Corps and Division signal organization TOE changes have recently been prepared and submitted by USASIGS for review and approval by TRADOC and DA. A draft copy of these changes was received on 25 October 1974, and will be used as a basis for preparing the respective baseline signal organizations for Task V.

A summary of signal organizations and the related management functions performed by applicable signal organizations for each of the INTACS concepts is presented in table 2-1. Note that changes in signal organization requirements are brought about by changes in doctrine and/or incorporation of selected communications options. The TOE's required to support these signal organizational requirements will be identified during INTACS Task V.

TABLE 2-1

Summary of INTACS Management Responsibilities

SIGNAL ORGANIZATION	MANAGEMENT RESPONSIBILITY	
	Concept ALPHA	Concept BRAVO
Theater Comm Command (TCC)		
Theater Army Comm Command (TACC)	Theater Army command and area systems. DCS entry stations.	Theater Army command and Theater Army and Corps area systems. DCS entry stations.
Theater Army Signal Brigade		
Corps Signal Brigade	Corps command and area systems plus artillery dedicated multichannel system.	
Corps Signal Group		Corps command system and artillery dedicated multi-channel system.
COSCOM Signal Battalion		
ADA Signal Battalion	ADA dedicated multi-channel system.	Same as Concept ALPHA.
Division Signal Battalion	Division command and control comm.	Concept ALPHA plus Brigade to Battalion multichannel systems.
Division Signal Company		
Divisional Brigade Comm Platoon	Brigade command and control comm.	ALPHA less Brigade to Battalion comm systems.
Separate Brigade Comm Platoon	Separate Brigade command and control comm.	
Separate Brigade Comm Company		Separate Brigade command and control comm (ext down to Battalion).
Armored Cavalry Regiment Comm Platoon	Armored Cavalry Regiment command and control comm.	Same as Concept ALPHA.

* Case I: Fluid situation.

** Case II: Non-fluid situation.

MANAGEMENT RESPONSIBILITY	
Concept CHARLIE	Concept ECHO
	Provides COMMZ services area and command comm systems for and under operational control of unified command (uses services/ DCS equipments. DCS entry stations in Theater and Corps. Assumes Army responsibility - USACC.
Case I: *Theater command and area systems. Case II: **Same as Case I, but area system extended thru Corps and into Division areas.	
	Theater Army command system.
	Corps command and area (primary) systems plus artillery dedicated multichannel system.
Corps command system and artillery dedicated multichannel system.	
COSCOM combined command and area system.	
Same as Concept ALPHA.	Same as Concept ALPHA.
Same as Concept ALPHA.	
	Division command and control mobile comm system.
Brigade mobile comm system.	Same as Concept CHARLIE.
Brigade mobile comm system.	Brigade mobile comm system.
Same as Concept ALPHA.	Same as Concept ALPHA. Mobile comm system option considered.

2.2 SUMMARY OF CONCEPT FUNCTIONAL AREAS

A summary of the thrust and the communications options comprising the four INTACS concepts appears in table 2-2. This table depicts the combinations of options to be incorporated in the INTACS candidates designs which will be evaluated. Upon completion of the candidate evaluation tasks, the results may indicate that a combination of the candidates (hybrid) will prove to be more cost-effective.

TABLE 2-2

Summary of Changes in Concept Functional Areas

CONCEPT	SWITCHING		M/C TRANS-MISSION	COMSEC	TCCF	RECORD TRAFFIC	SCA	S/C TRANS-MISSION	CP		TERMINALS
	Nodal	Unit Level							TOC	Distri-bution	
ALPHA Baseline, current TOE plus approved acquisi-tions	TOE + Auto Space-Div. 15 ea 300L 2 ea 600L	TOE + Semi-Auto Space-Div. (Limited quantity)	TOE	TOE	TOE	TOE	TOE	TOE	TOE	TOE	TOE + DTMF Telephone
BRAVO Improved HICAP ATACS plus FDMA TACSATCOM and SINCGARS	Unconstrain-ed 300/600L Auto Wide-Band Space-Division	Auto Space Division 30L in Div.	FDMA TAC-SAT (1 Sat), ADC, HSSDB, TDDM, MKS, BDE-BN LO Cap Exten-sion	VINSON, PARKHILL	Auto per SYSCON Study. Improved circuit & video techcon centers	FATT	SINC-GARS ARWI	SINCGARS Net Radio, FDMA TACSAT (1 Sat)	Integra-ted Ass-emblages incl Swbd	Radio vs cable bus	Wireline Adapter
CHARLIE MARTS for Bde, Hybrid TRITAC for Corps Sec-tor, ATACS for Theater	Auto Space & Time-Div 300/600L in Corps Sector	ULS 30-150L in Corps Sector	Uncon-strained SAT, DGM in Corps Sector, SRWBR, MARTS in Bde	TENELY in Corps Sector, VANDAL, GREATER ROLE	CSPE, CSCE & CNCE in Corps Sector	Message Switches 50L and 12/24L, COED, Data Adapter, Dig Fax in Corps Sector	ANRI in Corps, MARTS in Bde	ECCM, Improved HF	Integra-ted Assem-blage - No Swbd	MARTS in Bde	DSVT, DNVT in Corps Sector
ECHO Expanded Hybrid TRITAC all echelons, including DA TDMA TACSAT and MARTS	Auto Space & Time-Div 300/600L for entire Theater Army	Additional ULS 15L for entire Theater Army, QCS(M)	TROPO, DA TDMA TACSAT w/ ground backup, Laser/Fi-bers, MARTS in Division	TENELY, VANDAL, GREATER ROLE all echelons	CSPE, CSCE, & CNCE for en-tire Theater Army	QCS(M)	MARTS in se-lected units entire Theater QCS(M)	DA TDMA TACSAT, MARTS all echelons,	MARTS	MARTS	DSVT, DNVT all ech-elons, QCS(M)

Refer to C-E Assets, Appendix C for specific equipment for each concept and echelon.

2.3 SUMMARY OF C-E EQUIPMENT BY FUNCTIONAL AREAS

A summary listing of C-E equipments by functional area for each concept appears in table 2-3. This table identifies current TOE C-E equipments and approved acquisitions that will be used to configure multi-channel and single channel communication support facilities within Concept ALPHA, the baseline concept. In addition, C-E equipments to be introduced are identified in succeeding Concepts BRAVO, CHARLIE, and ECHO. During the evaluation of each candidate concept within Task V, a different mix of equipments may be needed to implement a more cost-effective hybrid concept.

REV4	SWITCHING FACILITIES		MULTICHANNEL TRANSMISSION FACILITI		
25 Oct 74	NODAL SWITCH	UNIT LEVEL SWITCH	VOICE & DATA MUX	LOS RADIO	TROPO RADIO
ALPHA Baseline System, Current TOE + limited automatic switching	MTC-1/9 TTC-38(15/2) --- CV-1918/9 as required	SB-993 SB-22 SB-86 MTC-3/7 TTC-29 TTC-23 TA-207 SB-3082	TCC-29 TD-660 TD-202 TD-203/4/6 TD-754 TD-352	GRC-103 Band I-III GRC-50 GRC-144	GRC-143 TRC-132 TRC-112 TRC-121
BRAVO Improved ATACS +FDMA TACSATCOM & SINCGARS	ALPHA + unconstrained 300/600 line auto wideband space as reqd --- CV-1918/9 as reqd ---	SB-3614 divisional +SB-22/993 --- Retain ALPHA EAD --- CV-1918/9 as reqd ---	ALPHA + TD-1065/9 TD-976/982 --- BDE-BN V/D/T Mux ---	GRC-103 Band I-IV GRC-144 --- BDE-BN RT-(GARS) constant keyed 70-88MHz ---	GRC-143 TRC-112 TRC-121
CHARLIE MARTS for Bde Area Hybrid TRITAC for Corps Sector ATACS for Theater	Hybrid TTC-39 f/Corps Cmd & COSCOM Cmd Sys --- BRAVO f/Thtr nodes	TRITAC 30-150L f/ Corps sec +SB-22/993 --- BRAVO f/Theater --- QCS	TRITAC DGM family f/ Corps sec --- BRAVO f/Thtr ---	BRAVO except see MARTS f/ Bde-Bn	NOT AVAIL
ECHO Expanded use of MARTS & TRITAC plus DA TDMA TACSATCOM for entire Theater	Hybrid TTC-39 f/entire Thtr +15/2 TTC-38 retained	TRITAC 15-150L +SB-993 --- QCS(M) ---	TRITAC DGM family f/Thtr --- See MARTS & TACSATCOM f/ reduced use	CHARLIE --- See MARTS & TACSATCOM f/ reduced use	TRITAC DIGITAL TROPO for Theater Rear

2

TABLE 2-3 Details of Concept Functional

SION FACILITIES				COMSEC			COMMUNICATIONS SYS PLAN ENGR & CONTROL (TCCF)		RECORD TRA TELECOMMUN
	TROPO RADIO	TACSAT RADIO	DOWN THE HILL	STATIC SWITCH	MOBILE RADIO	MSG&DATA PROCESSING	SYSCON & PLANS	NODAL EQUIP	STATIC
III	GRC-143 TRC-132 TRC-112 TRC-121	NOT AVAILABLE	CX-11230	KG-27 KG-13 KG-30/31	KY-8 KY-28 KY-38	KW-7 KL-7 KG-13 KG-30/31	MSC-31/32 MSC-25	SB-675 TSC-76	TT-4 TT-76 TT-98 TXC-1 GXC-5 GSQ-80 --- AUTODIN Entry
V ---) eyed ----	GRC-143 TRC-112 TRC-121	TSC-85V1 TSC-85V2 TSC-86 MSC-59 --- 1 Sat constraint	GRC-144 Modified M/C Keying System +ALPHA	ALPHA+ KYX-57 KY-57 KYK-13 KYX-15 KOI-18 --- 10% Corps sector loops	KY-57 KY-58 KYK-13 KYX-15 KOI-18 KY-65/75 PACER 63- Maneuver Bn Cmd CO/2/3/CE 1/function	ALPHA+ Static & Mobile BRAVO COMSEC	MSC-(I/O) MSC-(P)	EAD TSQ-84(A) TSQ-85 DIV TSC-76	FATT Sml/Lge DATA/TTY Terminals Analog Fa --- AUTODIN Entry --- GSQ-(M)
ee	NOT AVAIL	BRAVO --- Sats not constrained	TRITAC SRWBR +ALPHA	KY-68 KG-84 KG-82/83 KG-27 KG-81 f/Corps-- --- BRAVO f/ Theater --- 10%loop	VANDAL GREATER ROLE MARTS optimized ULS interface PACER 63-(middle) BRAVO+log 1/net	KG-84 VANDAL GREATER ROLE --- BRAVO f/ Theater ---	TRITAC CSCE CSPE f/Corps sector --- BRAVO f/ Theater --- TACSATCOM	TRITAC CNCE CESE f/ Corps sector --- BRAVO f/ Theater ---	TRITAC TI COED+FATT f/Corps --- 12/24 ch ULS Msg --- TTC-39S&I f/Corps --- BRAVO f/T
--- S & M f/ use	TRITAC DIGITAL TROPO for Theater Rear	DA TDMA TACSATCOM TSC-(S) TSC-(M) TSC-(L)	Laser/ Fibers .LT.1mi --- GRC-( ) f/1-5mi ---	TRITAC f/Theater --- All COMSR &PACER ---	VANDAL Gtr Role --- MARTS optimized f/KG-82 --- All COMSR &PACER All stns 1/net	TRITAC VANDAL Gtr Role f/Theater	TRITAC f/Thtr	TRITAC f/Thtr --- See MARTS f/Div ---	QCS(M)&DI TRITAC TDF,COED TTC-39S&I Data Ada f/Theate

oncept Functional Areas

	RECORD TRAFFIC TELECOMMUNICATIONS		SINGLE CHANNEL ACCESS (MSA)		SINGLE CHANNEL TRANSMISSION (SINCTRAC)			
	STATIC	MOBILE	MARTS	RWI	HF/SSB	VHF/FM	INDIV HANDHELD	TACSATCOM
	TT-4 TT-76 TT-98 TXC-1 GXC-5 GSQ-80 --- AUTODIN DCS Entry	GRC-142 GRC-122 MRR-8/MRT-9 VSC-2/3 --- Air/Gnd Messenger ---	NOT AVAILABLE	GSA-7 GRA-39 --- limited C-6709 --- nonsecure	GRC-106 PRC-74 ARC-102 --- TSC-18/20 DCS Entry ---	RT-524 RT-246 R-442 PRC-77/25 ARC-131 ARC-114 HYL-3 --- U-21/149 ASC-15	PRT-4 PRR-9	NOT AVAILABLE
)	FATT Sml/Lge DATA/TTY Terminals Analog Fax --- AUTODIN DCS Entry --- GSQ-(M)	ALPHA + GRC-122V2 GRC-142(S) +see S/C TACSATCOM	NOT AVAILABLE	unlimited C-6709 GSA-(MAS) --- securable ---	ALPHA + PRC-70	RT-(GARS) R-(GARS) Veh/Air Adapters PRC-70 MX-933i --- LOH/ARC-() ASC-(GARS)	PRC-68 securable	RT-(SATS) PSC-(SATS) MSC-(SATS) GSC-(SATS) + ALPHA --- See M/C TACSATCOM for constraint
--	TRITAC TDF COED+FATT f/Corps sec --- 12/24 chan ULS Msg Sw --- TTC-39S&F+DA f/Corps sec --- BRAVO f/Thtr	MARTS + CHARLIE STATIC assets & RATT (HF+SAT)	Sep&Div Bdes SU1 REU SAU (No ECCM) (MSC)	TRITAC GSA-(C) QCS --- Secure f/ Corps sec ---	USMC PRC-104 family ACC-174 VCC-169	BRAVO (+ECCM)	BRAVO	BRAVO Sats Unconstrained
--	QCS(M)&DMD TRITAC TDF,COED & TTC-39S&F+ Data Adapter f/Theater	MARTS + ECHO STATIC assets	CHARLIE + Division &Selected EAD Users (+ECCM)	TRITAC Option 10 SU4 QCS(M) --- Secure ---	NOT AVAILABLE	BRAVO (No ECCM)	CHARLIE	RT-(DA) PSC-(DA) MSC-(DA) GSC-(DA)

		CF COMMUNICATIONS		TERMINALS		
TACSATCOM	ATC VHF/UHF	TOC	DISTR	TP	DATA FAX TTY	CABLE &WIRE
NOT AVAILABLE	ARC-115A ARC-116 PRC-41 PRC-90 URC-10 VRC-24	See COMSEC, SWITCHING REC TRF SNGL CHAN WIRE &TERM --- Dedicated Circuits	See Wire &Cable --- Msgr Tm ---	TA-312 TA-1 TA-341	TT-4 TT-76 TT-98 DSTE TXC-1 ARTADS +CS3 --- No QCS	WD-1 CX-4566 WF-16 CX-11230
RT-(SATS) PSC-(SATS) MSC-(SATS) GSC-(SATS) + ALPHA --- See M/C TACSATCOM for constraint	ARC-164 PRC-66 +ALPHA	INTEGRATE OTHER BRAVO FUNCTIONS INTO TOC ASSEM-BLAGE --- TOC SWBD ---	RADIO w/ckt concen-trator TDX/Swbd + ALPHA	TA-838 TA-938 +ALPHA	ALPHA+ FATT Analog	ALPHA
BRAVO Sats Unconstrained	BRAVO	CHARLIE FUNCTIONS INTEGRATE --- No TOC Swbd ---	BRAVO	DSVT DNVT +ALPHA	QCS TDF COED +BRAVO	ALPHA
RT-(DA) PSC-(DA) MSC-(DA) GSC-(DA)	BRAVO+ MARTS	ECHO FUNCTIONS INTEGRATE --- MARTS ---	BRAVO +MARTS	DSVT DNVT +ALPHA	QCS(M) DMD + CHARLIE	ALPHA

2.4 MAJOR FUNCTIONS (MULTICHANNEL AND SINGLE CHANNEL)

The refined Government-furnished communications concepts are summarized in subsequent paragraphs of this section. Figures 2-1 through 2-3 are offered to facilitate a ready comparison of the concepts. Figure 2-1 shows the area of coverage for the multichannel and single-channel communications system for the baseline concept (Concept ALPHA). Coding is employed (see legend) to denote major communications materiel used to implement each of the communications systems by echelon. Figures 2-2 and 2-3 present comparisons between Concept ALPHA and each of the alternative concepts in terms of communications system area of coverage and materiel utilized to implement the systems. A summary of each alternative concept is presented in subsequent paragraphs. (Appendix C contains a listing of communications materiel for each concept.)

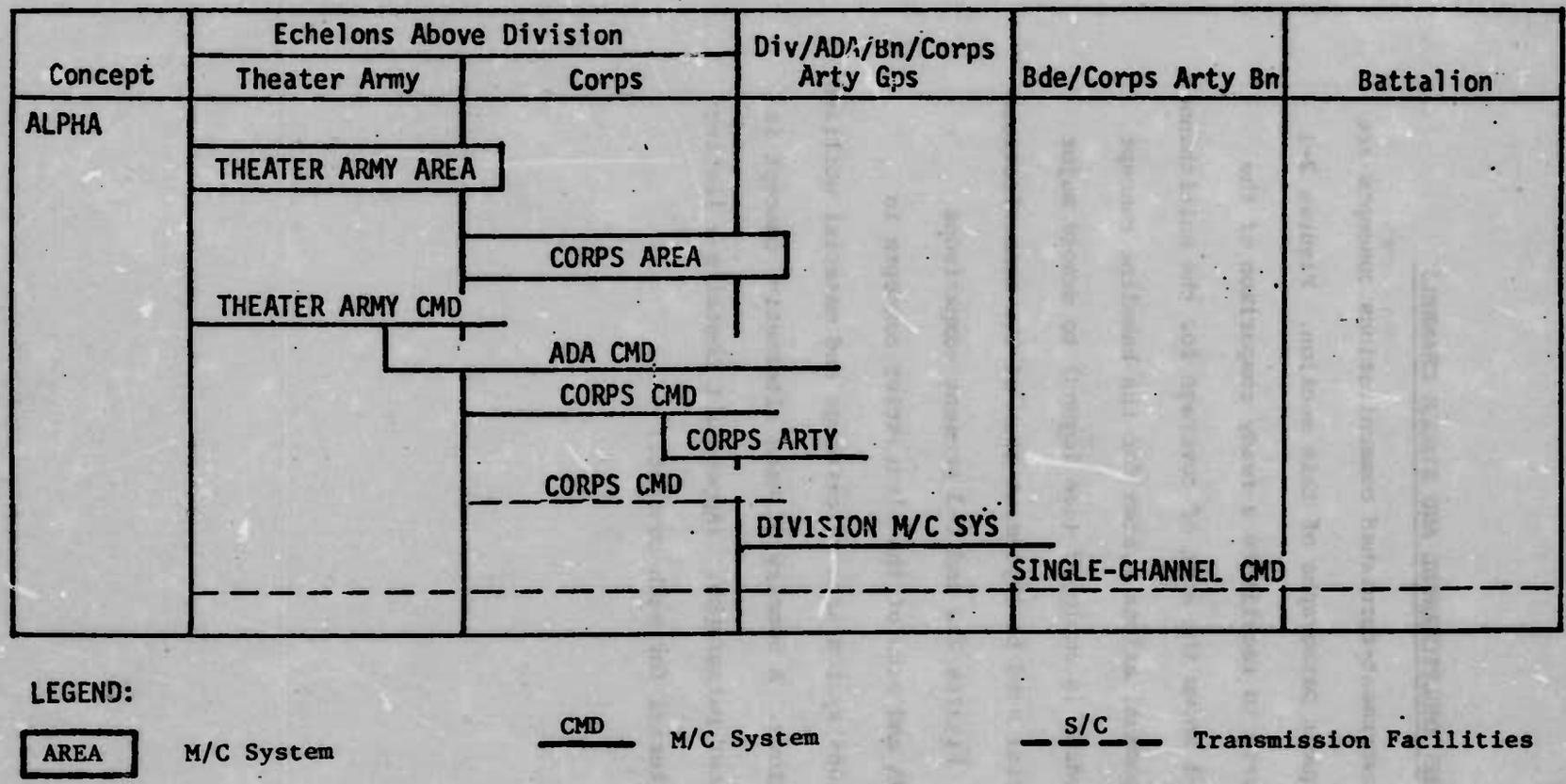


FIGURE 2-1 Concept ALPHA Summary

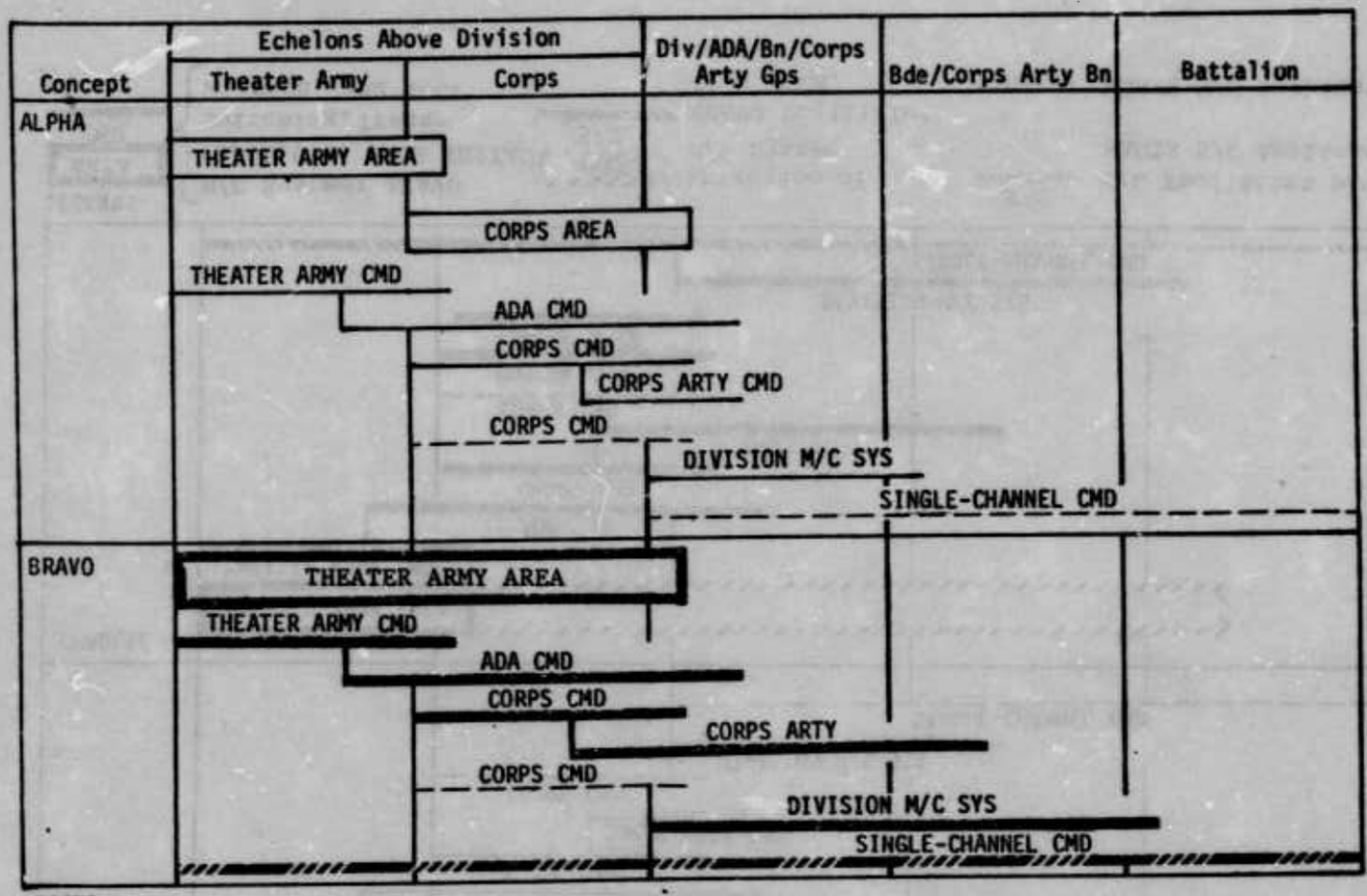


FIGURE 2-2 Summary Comparison of Concepts ALPHA and BRAVO

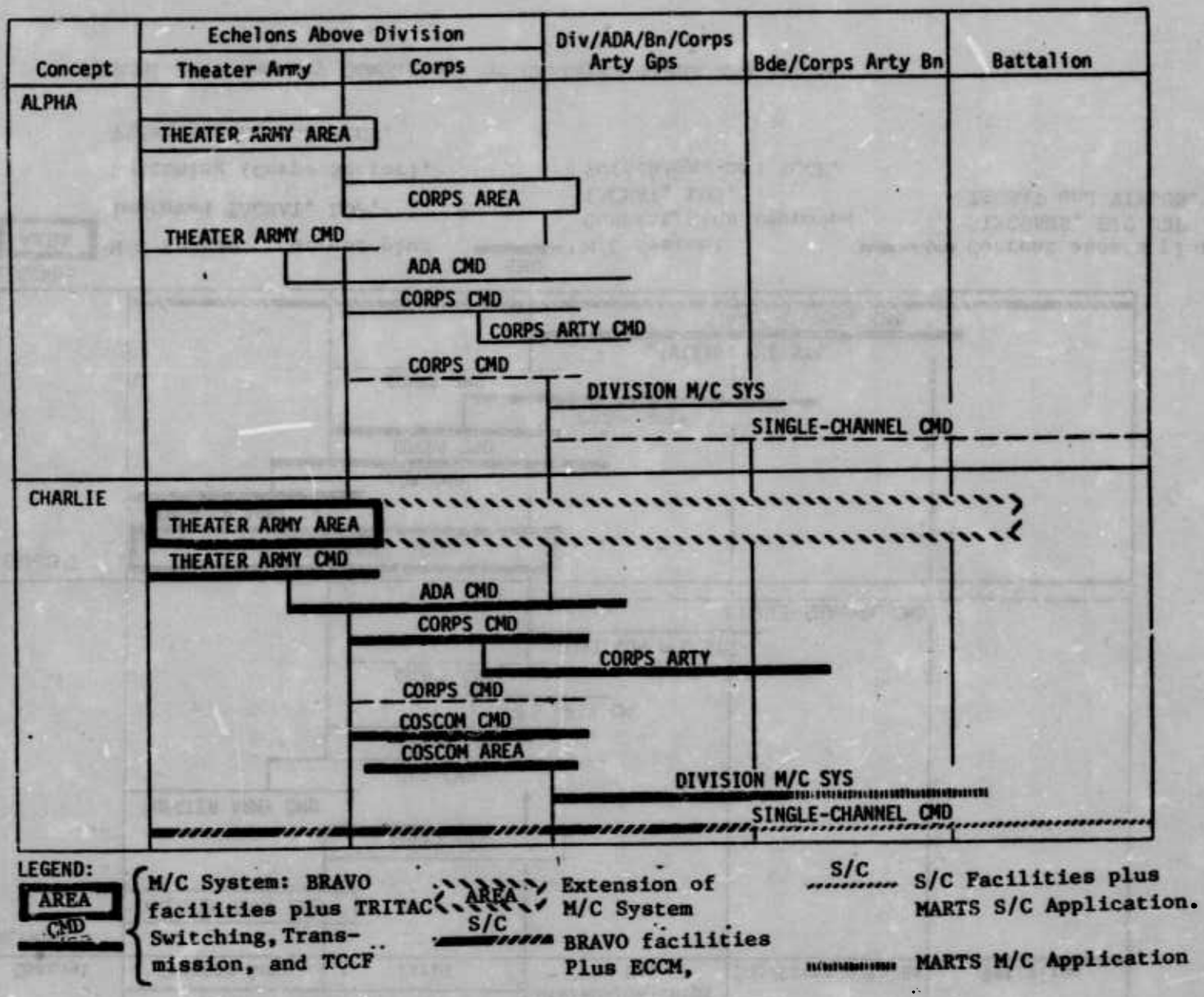


FIGURE 2-3 Summary Comparison of Concepts ALPHA and CHARLIE

2.4.1 Multichannel Major Functions

The multichannel communications facilities to be employed in the MRTF communication Concepts ALPHA, BRAVO, and CHARLIE are summarized in figures 2-4 through 2-7. Each figure illustrates the following major multichannel communication functions:

Transmission (including SHF TACSAT), communication control, switching and distribution (including extension subsystems). Distribution includes telephone, data, teletype, radio wire integration, and MARTS.

Changes in any multichannel major function for a given concept are denoted by heavy-outlining of equipment blocks, and by heavy underscoring of equipment nomenclatures. A heavy dashed line appears in each figure to denote which major multichannel function has either a digital or analog capability. The baseline concept, ALPHA, and changes introduced by subsequent Concept BRAVO and CHARLIE are described in the following paragraphs.

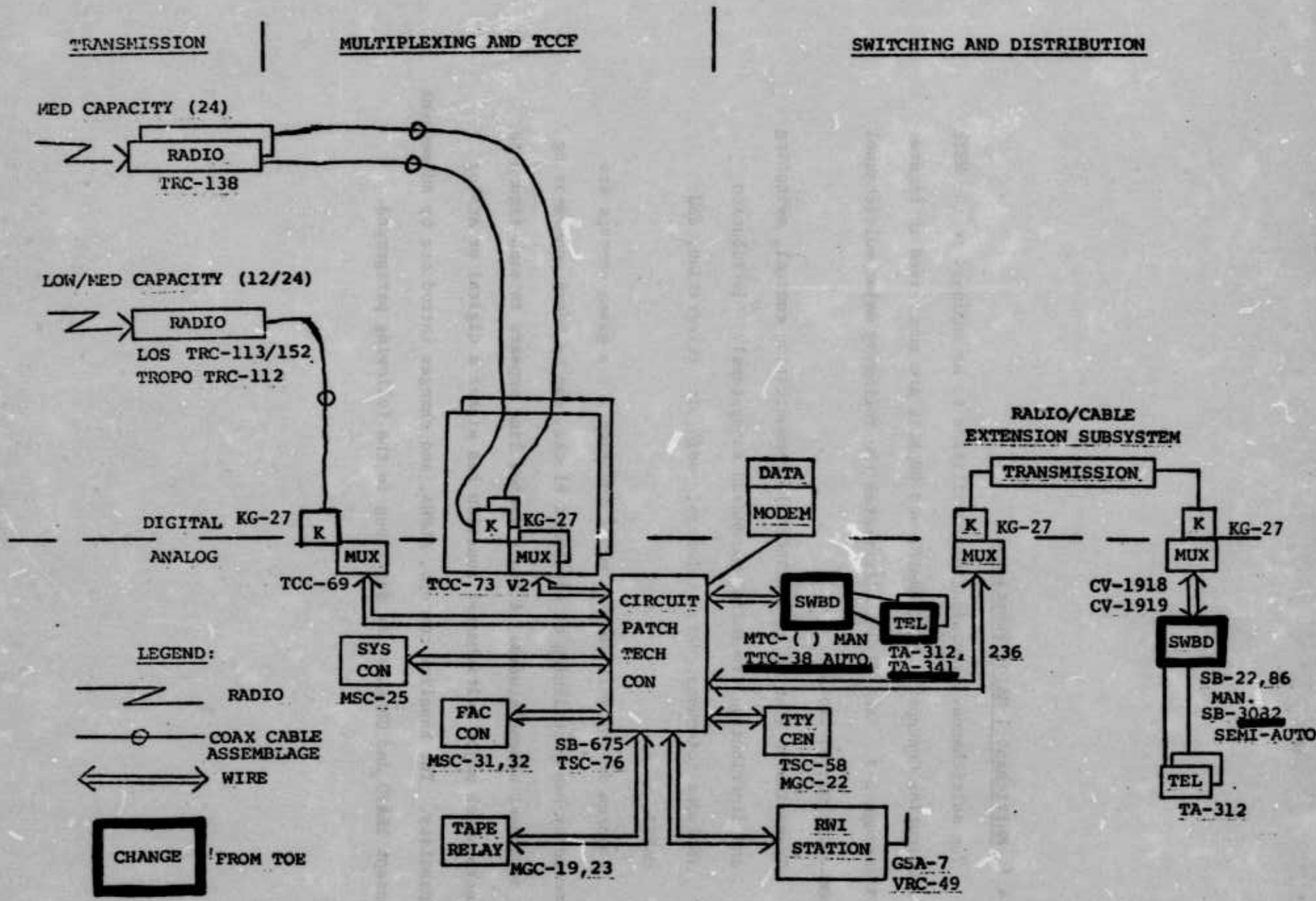


FIGURE 2-4 MULTICHANNEL MAJOR NODE FUNCTIONS - ALPHA

2.4.1.1 Concept ALPHA

Figure 2-4 shows the major multichannel node functions and equipments for Concept ALPHA with transmission on the left, multiplexing and TCCF in the middle, and switching and distribution on the right. Note that with the exception of three (heavy outline), all equipments are identified by current TOE's. ALPHA is basically characterized by analog distribution with digital link transmission as indicated by the analog-digital dashed line on the figure. Equipment changes from TOE in Concept ALPHA are:

- TTC-38 Automatic space-division wideband 300/600 line switch
  (Limitations are: fifteen 300-line and two 600-line switchboards.)
- TA-341 DTMF Telephone.
  (Limitation is: 3290 units.)
- SB-3082 Semi-Automatic space division 50/100-line switch.
  (Limitation is: 176 units.)

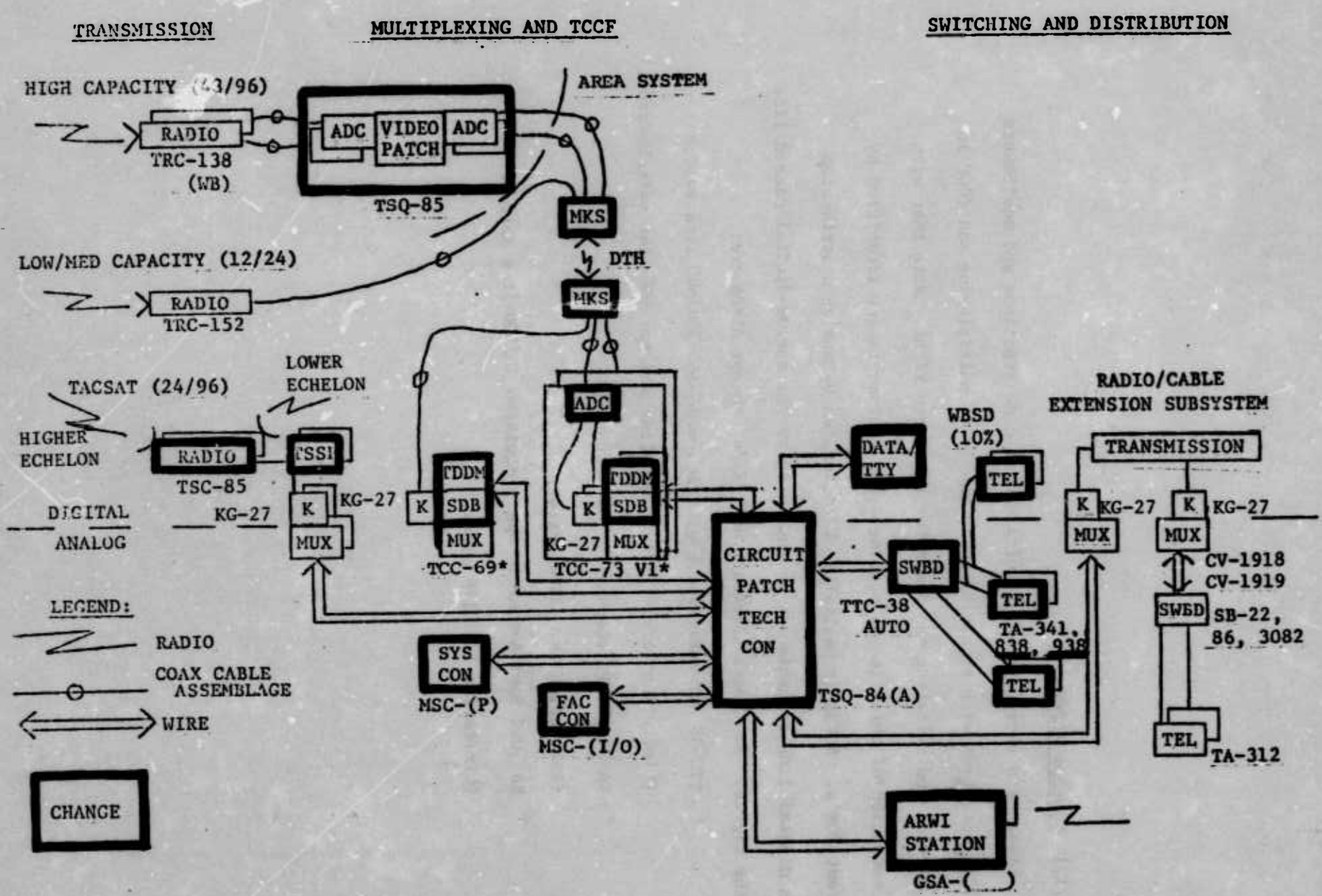


FIGURE 2-5 MULTICHANNEL MAJOR NODE FUNCTIONS - BRAVO - EAD

2.4.1.2 Concept BRAVO - EAD

Concept BRAVO - EAD introduces new multichannel communications facilities for TACSAT transmission, multiplexing, communications control and distribution. The specific equipments as identified in figure 2-5 are:

Transmission Facilities:

- Preassigned FDMA TACSAT - one terminal required for transmission to the higher echelon and one terminal for transmission to the lower echelon.
- Multichannel Keying System (MKS) augments cable for down-the-hill facilities.

Multiplexing:

- The time division digital multiplexer (TDDM) and the serial data buffer (SDB) allow injection of data and teletype into the transmission links.
- The multiplexer assemblage (TCC-73V1*), incorporates the asynchronous digital combiner (ADC). The TSQ-85 Video Technical Control Center with ADC's and Video Patching along with the TRC-138 with wide band (WB) modem are components of the HICAP (48/96-channel) area system.

TCCF:

- The TSQ-85, TSQ-84(A) Technical Control Centers along with MSC-(P) and MSC-(I/O) system control and facilities control functions provide automated communication control capabilities.

Distribution:

- The current manual RWI station is replaced with SINCTRACS semi-automatic RWI unit, AN/GSA-( ).

COMSEC:

- Multichannel transmission COMSEC devices are the same as for Concept ALPHA (KG-27).
- COMSEC for wire loops is upgraded by the introduction of VINSON.
- Up to 10% of the wire loops in the corps sector will be allocated on-line COMSEC devices (wide band security device (WBSD)). No percentage will be imposed in Theater.

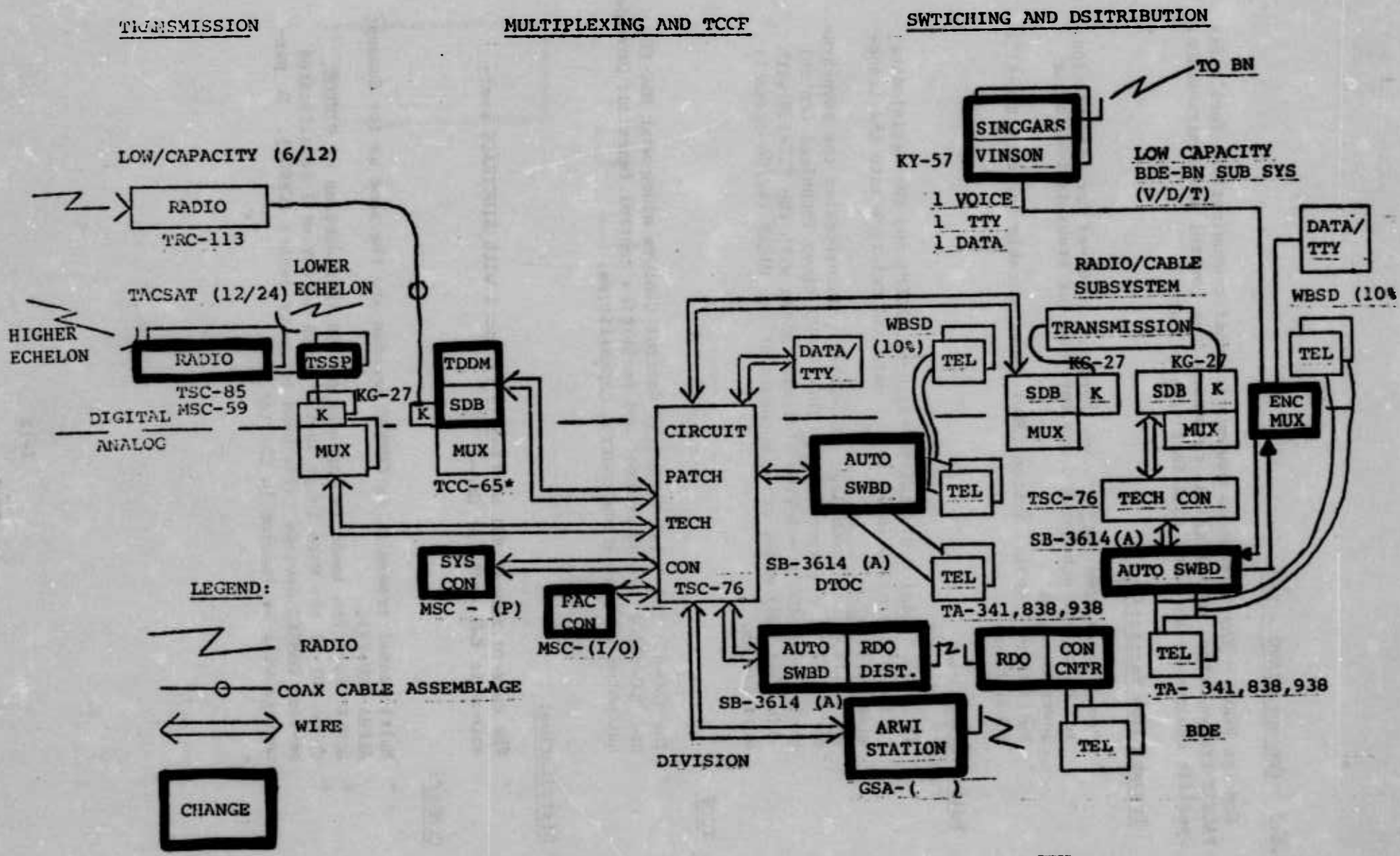


FIGURE 2-6 MULTICHANNEL MAJOR NODE FUNCTIONS - BRAVO - DIVISION AND BRIGADE

2.4.1.3 Concept BRAVO (Division/Brigade)

In Concept BRAVO for the Division and Separate Brigade, new multichannel communications facilities are introduced for improved switching, CP communications and extension of the multichannel system down to the maneuver battalions. The improvements introduced are denoted in figure 2-6 by heavily outlined equipment blocks and are identified as follows:

- SB-3614 in the Division and Brigade
- Radio CP distribution system
- SINCTRACS RWI, the GSA-( ).
- Low capacity BDE-BN extension system providing one each secure voice, TTY, and data channels
- Use of the TCCF components MSC-(P) and MSC-(I/O) in the Division
- On-line COMSEC allocations (WBSD) will be restricted to a maximum of 10% of the total number of loops.

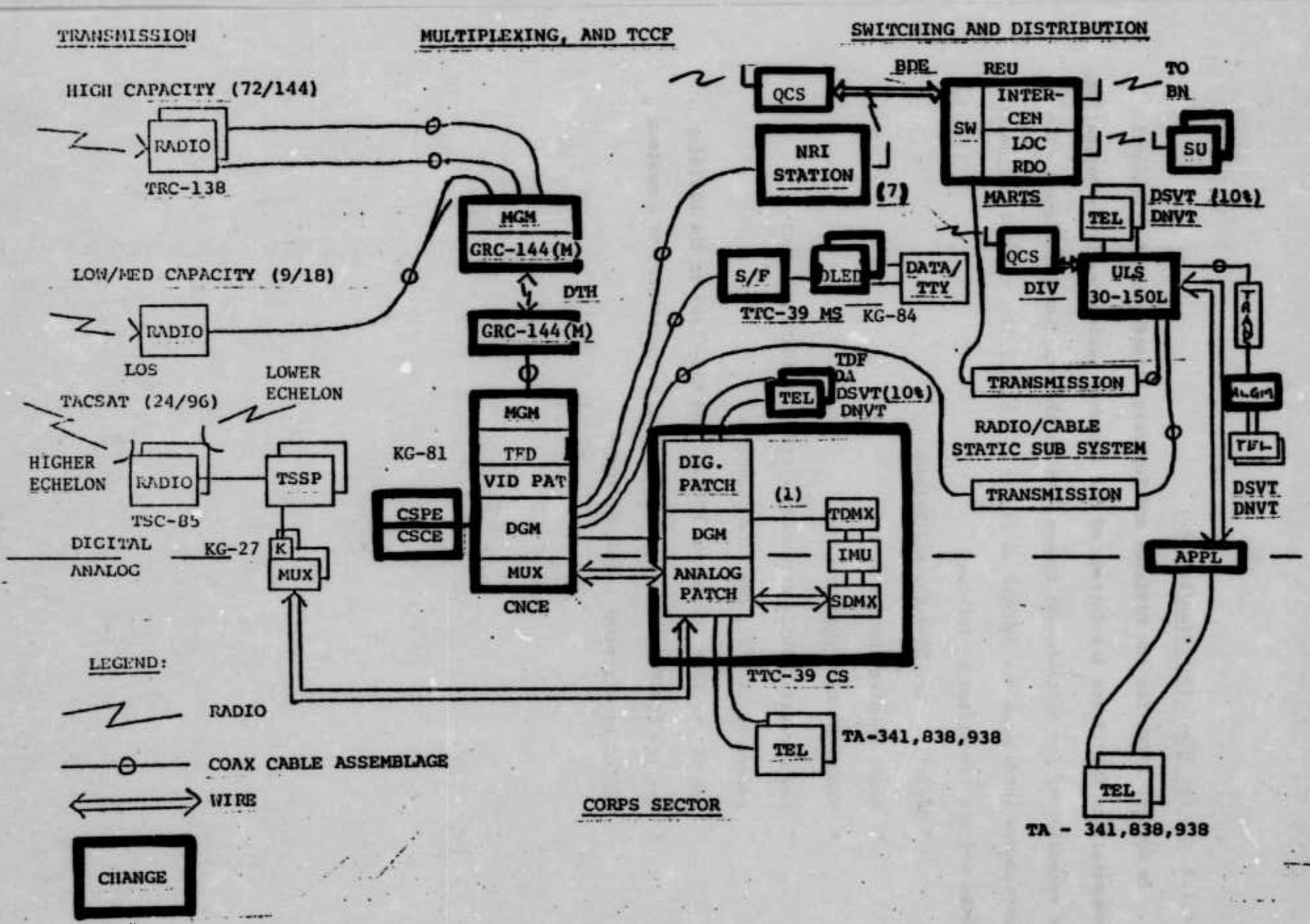


FIGURE 2-7 MULTICHANNEL MAJOR NODE FUNCTIONS - CHARLIE

2.4.1.4 Concept CHARLIE

Concept CHARLIE introduces the TRITAC equipments in the Corps Sector as illustrated in figure 2-7. Note that CHARLIE has stepped to a predominantly digital capability as indicated by the analog-digital dashed line in the figure. The transmission equipments including TACSATCOM remain the same except for the down-the-hill system where the Master Group Multiplexer (MGM) and the Short Range Wide Band Radio (SRWBR) provide this capability. The other changes are as follows:

TCCF: The Tactical Communications Control Facilities family (system planning, system control and nodal control, CSPE, CSCE and CNCE, respectively) are introduced to provide automated control capabilities. The CNCE contains the Digital Group Multiplexer (DGM) family, video patching, and trunk encryption devices (K_2).

Switching:

- The TTC-39 circuit switch (CS) provides both digital (TDMX) and analog (SDMX) switching matrices with analog-to-digital conversion in the intermatrix (IMU). The TTC-39 message switch (MS) provides store and forward (S/F) capability.
- The digital unit level switch (ULS), limited to 30-150 lines, is employed in upper division. An applique is provided for analog telephone switching.

Mobile Distribution:

- The RWI is implemented with the digital TRITAC optior 7 (net radio interface (NRI)). An operator is required for call set-up and keying is automatic.
- Mobile Automatic Radio Telephone System (MARTS) is introduced in BRIGADE to replace switched-wire communications and administration/logistic nets within the separate and divisional brigades.
  - Provides system users a highly mobile, digital, all secure communications facilities.
  - Range Extension Unit (REU) provides local users a retransmission capability, plus total area coverage by multichannel REU-to-REU transmissions. The switching facility provides for interfacing with s/c and m/c communications facilities.
  - Subscriber Unit (SU) provides for direct user-to-user communications plus accessing the REU for range extension or gaining access to other communications facilities.

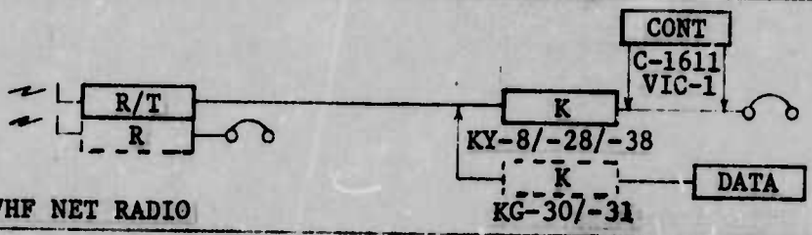
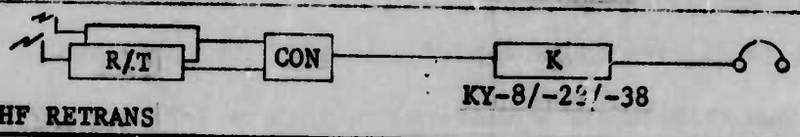
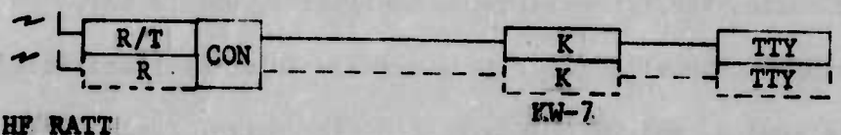
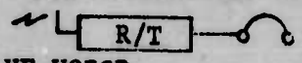
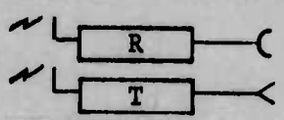
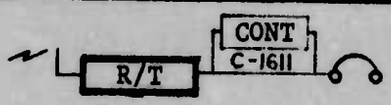
QCS: Query Control Station provided for S/C interfacing by ARTADS users.

COMSEC:

- TENLEY equipment is introduced into the Corps sector. BRAVO continues to be used in Theater.
- MARTS COMSEC will be compatible for interface with the ULS.
- On-line device (DSVT) allocations are restricted to 10% maximum in Corps Sector; no percentage restriction is imposed in Theater.

2.4.2 Single Channel Major Functions

The single channel facilities to be employed in MRTF communication Concepts ALPHA, BRAVO, and CHARLIE are summarized in figures 2-8 through 2-10. Major single channel communication functions illustrated in these figures are: VHF net radio, VHF retransmission facilities, UHF TACSAT, HF RATT, MARTS, VHF single channel access, data message interface facilities, HF voice, VHF handheld radios, and VHF/UHF air traffic control facilities. Dashed equipment blocks designate optional components which may be deployed based upon need and availability. Changes in any single channel major function for a given concept are denoted by heavy outlining of equipment blocks and by heavy underscoring of equipment nomenclatures. A heavy dashed line appears in each figure to denote which major single channel funetion has either a digital or analog transmission capability. The baseline Concept, ALPHA, and changes introduced by subsequent Concepts BRAVO and CHARLIE are described in the following paragraphs.

TRANSMISSION	COMSEC	EQUIPMENT
 VHF NET RADIO		PRC-77 SERIES VRC-12 SERIES ARC-114/-131 ASC-15
 VHF RETRANS		VRC-49 U-21/ARC-149 HYL-3
 HF RATT		GRC-122/-142 VSC-2/-3 MRR-8/MRT-9
	DIGITAL / ANALOG	
 VHF SCA		VRC-49 GSA-7 C-6709 W/TAS
 HF VOICE	OP CODES	PRC-74; GRC-106; ARC-102
 VHF HANDHELD	OP CODES	PRR-9; PRT-4
 VHF/UHF ATC	OP CODES	ARC-115A/-116 PRC-41/-90 URC-10; VRC-24/-54

CHANGES *

* CHANGES FROM CURRENT TOE'S

FIGURE 2-8 Single Channel Major Functions - ALPHA

2.4.2.1 Concept ALPHA

The equipments to be employed in the configuration of the various single channel transmission facilities for Concept ALPHA are identified by equipment nomenclature per major communication functions in figure 2-8. It should be noted that with the exception of two equipments for Concept ALPHA, all other equipments are identified by current TOE's. Equipments added to Concept ALPHA are:

- C-6709, A Radio Control unit that provides the tactical automatic switch (AN/TTC-38) user a semi-automatic RWI capability.
- AN/ARC-115A, Radio Set has improved capabilities over the AN/ARC-115 necessary to meet new FAA requirements.

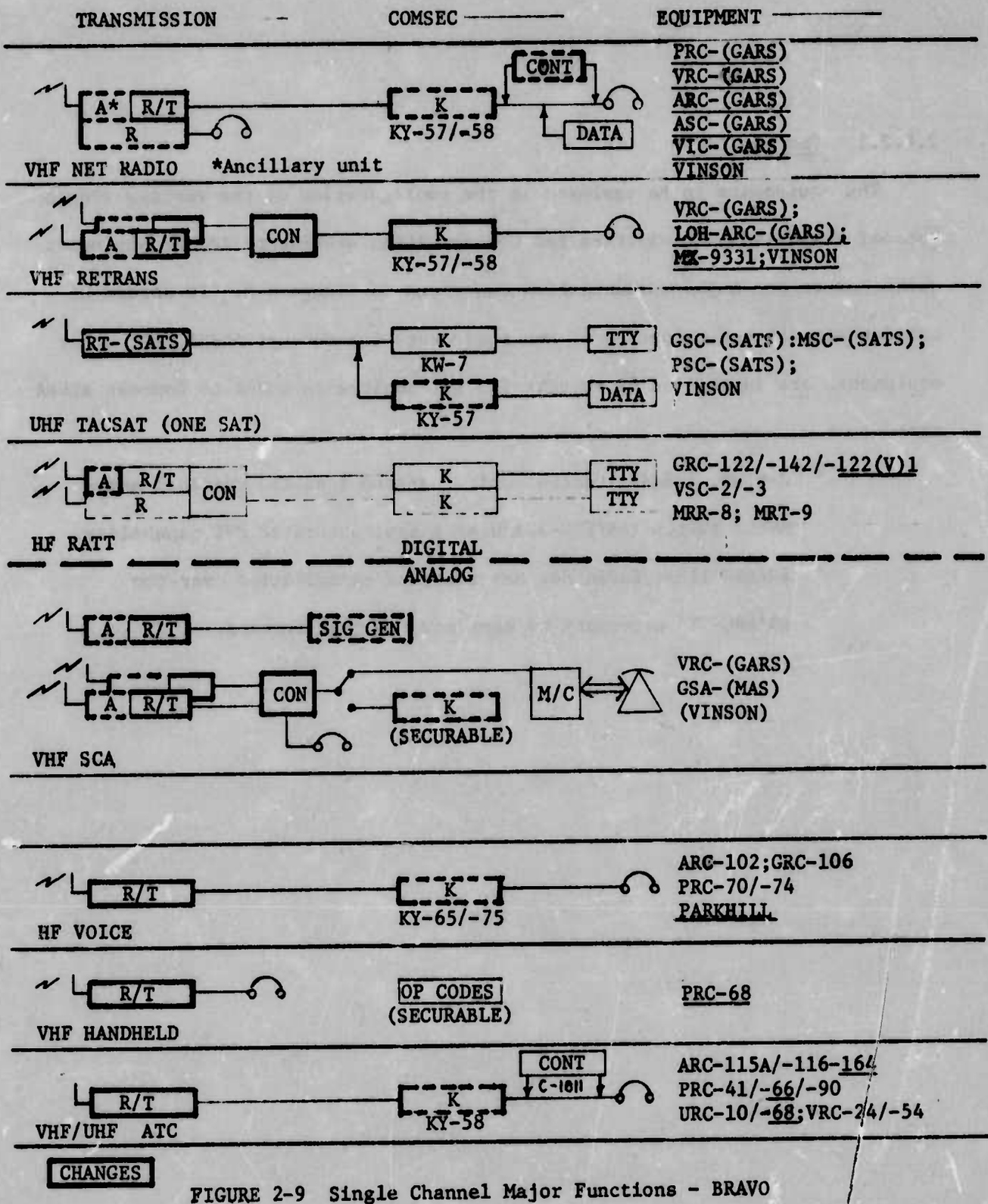


FIGURE 2-9 Single Channel Major Functions - BRAVO

2.4.2.2 Concept BRAVO

Concept BRAVO introduces new s/c communications facilities for HF, VHF, VHF/UHF, and UHF (TACSAT) communications. The specific equipments added are identified by major function in figure 2-9. A discussion of these added communications facilities follows:

° VHF Transmission Facilities:

- The SINCTRACS Ground-Air Radio System (GARS) replaces the AN/VRC-12 series on a one-for-one basis.
- VINSON COMSEC
- Changes in retransmission (securable) facilities, viz., replacement of HYL-3/TSEC with MX-9331 and replacement of U21/ARC-149 with LOH/ARC-(GARS)
- Replacement of current manual TWI with SINCTRACS semi-automatic RWI unit the AN/GSA-(GARS)
- The AN/PRC-68 replaces the present hand held radios (securable).
- Selected application of AN/PRC-70 and HF/VHF radio set.

° HF Transmission Facilities:

- The addition of AN/GRC-122(V)2, high power version of AN/GRC-122
- Selected application of AN/PRC-70 HF/VHF radio set
- PARKHILL for voice transmissions.

° Air Traffic Control Transmission Facilities:

- Selected application of AN/ARC-164, AN/PRC-66 and AN/URC-68
- Securable with VINSON.

° TACSAT Transmission Facilities:

- Single satellite
- Single channel UHF TACSAT communication facilities. Equipments are: manpack, base station, and RATT terminal.
- Data and voice transmissions securable by VINSON and PARKHILL respectively.

° On-line COMSEC is allocated according to PACER ranking down through the maneuver battalions with one device per function to the CO/S2/S3/CE.

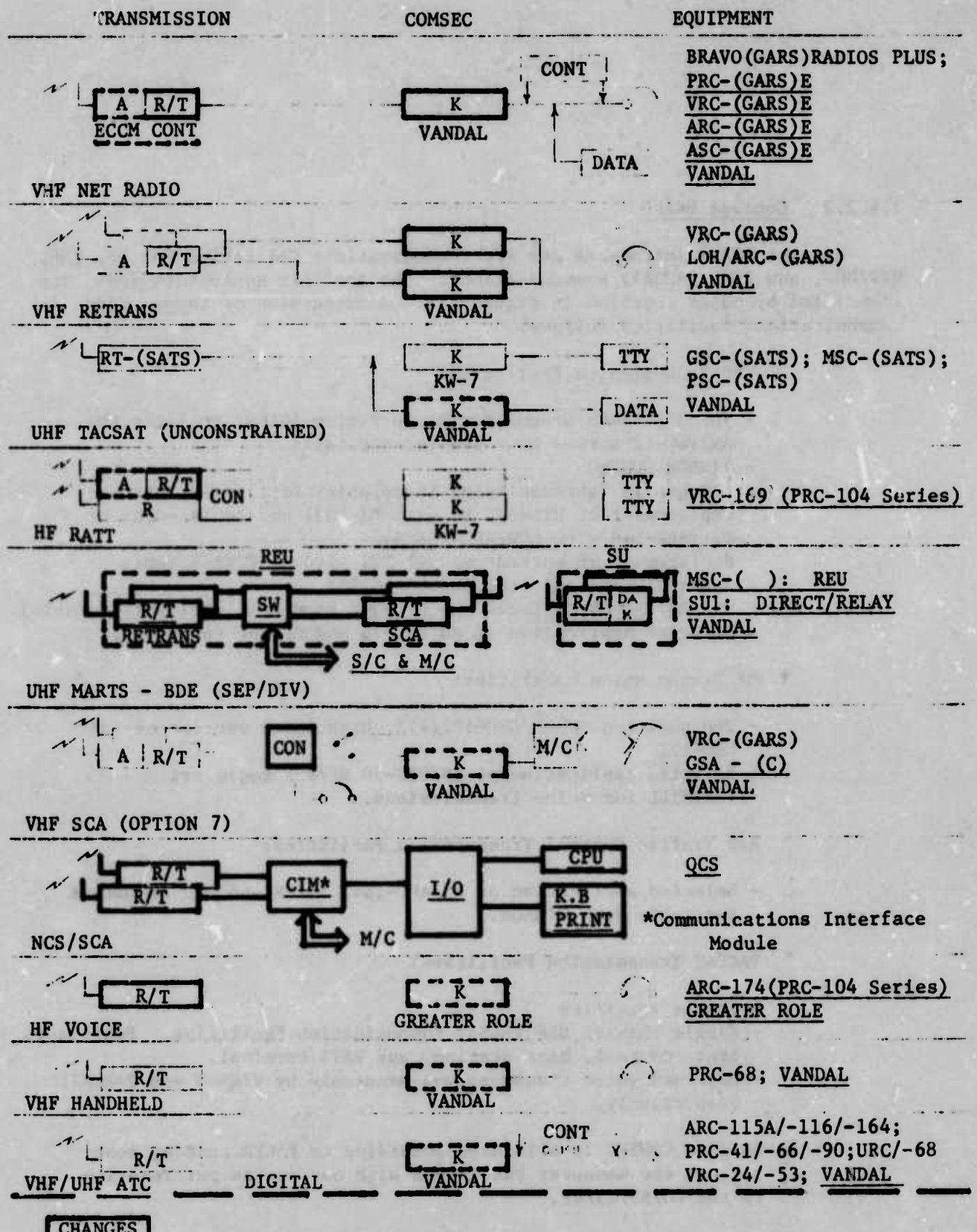


FIGURE 2-10 Single Channel Major Functions - CHARLIE

2.4.2.3 Concept CHARLIE

Concept CHARLIE retains selected Concept BRAVO s/c communications facilities and introduces ECCM, Mobile Automatic Radio Telephone System (MARTS), plus new COMSEC, HF radio sets, RWI, and communications interface facilities. The specific equipments are identified by nomenclature for each major s/c communications function in figure 2-10. These added facilities are as follows:

- VHF Transmission Facilities:
  - Selected application of SINCTRACS ECCM capabilities
  - VANDAL COMSEC
  - MX-9331 deleted with introduction of new COMSEC
  - RWI implemented with the digital TRITAC Option 7. Operator required for call set-up and keying is automatic.
- HF Transmission Facilities:
  - HF transmission facilities of Concept BARAVO replaced with AN/PRC-104 series (AN/VRC-169 for HF/RATT, AN/ARC-174 and AN/PRC-104 for HF/VOICE)
  - GREATER ROLE introduced for voice security.
- Air Traffic Control Transmission Facilities:
  - VANDAL COMSEC
- TACSAT Communications Facilities:
  - Unconstrained satellite
  - Data and voice transmissions securable with VANDAL and GREATER ROLE respectively.
- Mobile Automatic Radio Telephone System (MARTS) Facilities:
  - Replaces switched-wire communications and administration/logistic nets within the separate and divisional brigade
  - Provides system users a highly mobile, digital, secure communications facilities
  - Equipments:
    - Range Extension Unit (REU) provides local users a relay capability, plus total area coverage by multichannel REU-to-REU transmissions. The switching facility provides for interfacing with s/c and m/c communications facilities.
    - Subscriber Unit (SU) provides for direct user-to-user communications plus accessing the REU for range extension or gaining access to other communications facilities.
- Communications Interface Facilities:
  - Communications interface facilities are provided by Query Control Station (QCS)
    - Provides interfacing capabilities between switched-wire and radio communications facilities
    - Provides SCA and NCS facilities
- COMSEC on-line allocations are extended to include half of the remaining PACER rankings, and logistic functions are given security devices.

Concept CHARLIE provides a digital transmission capability and facilitates secure transmissions for all single channel major functions shown in figure 2-10.

3.0 SUMMARY OF ECHO CONCEPT, EMPLOYMENT, AND POTENTIAL

3.1 CONCEPT ECHO SUMMARY

The communications support requirements and communications areas serviced, by echelon, for Concept ECHO are identical to those of Concept ALPHA. Thus, the differences between Concepts ALPHA and ECHO result from changes in doctrine, introduction of new and improved materiel, and subsequent changes in signal organization to accommodate the changes in doctrine and the addition of new communications materiel. (Figure 3-1 presents a graphic comparison between Concepts ALPHA and ECHO.) Detailed communications materiel assets for Concept ECHO are listed for each echelon in Appendix C. The differences between the ALPHA and ECHO Concepts are summarized as follows:

- ° Doctrinal changes
  - Incorporation of changes in doctrine necessary to accommodate the introduction of new communications materiel.
  - Responsibility of the Theater Communications Command (TCC) to provide and control unified area communications support to all component commanders within the COMMZ using Army personnel and equipment. In addition, the TCC will provide and control the command control communications system for the unified commander down to the component commanders.
  - Responsibility of the Theater Army signal organization to provide direct command, Theater Army support command, and ADA communications support.
  - Responsibility of the Corps and Division signal organizations to extend artillery multichannel communications systems down to the artillery battalions.
  - Replacement of the Division multichannel system (and selected radio nets) by MARTS, and MARTS employment in selected EAD units.
- ° Introduction to the maximum extent possible of TRITAC and SINCTRAC equipment.

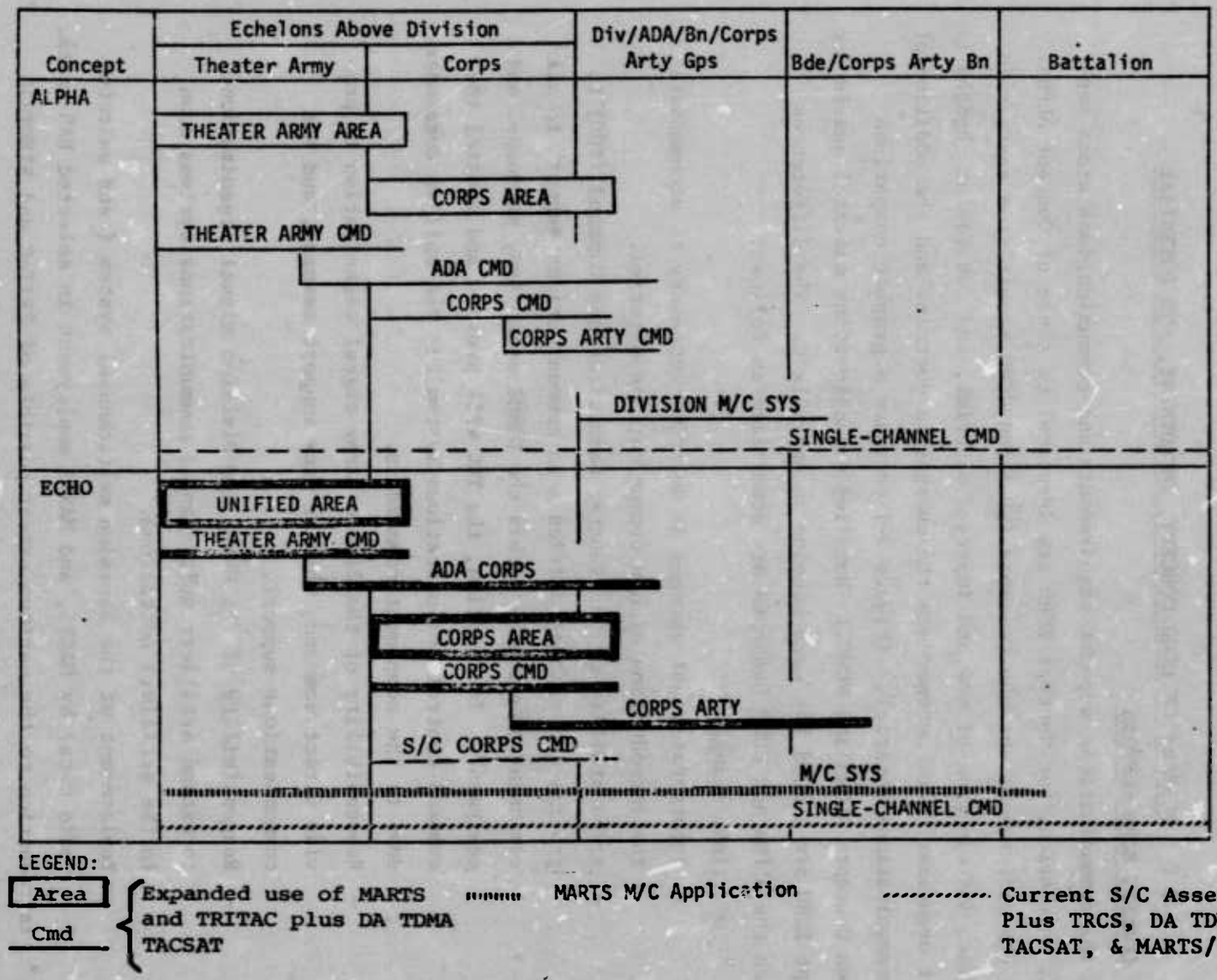


Figure 3-1 Summary Comparism of Concepts ALPHA and ECHO

° Signal organization changes

- Modification of the TCC signal organization to reflect:
  1) The change in operational control for the COMMZ area system from the component commander to the unified commander
  2) The addition of new communications materiel
- Modification of the Theater Army Signal Organization to reflect:
  1) Introduction of MARTS to selected units
  2) The additon of new communications materiel
- Modification of the Corps signal organization to accommodate:
  1) Extension of the Corps communication system down to the Division MARTS interface to support those Corps units normally operating in the Division area of operations.
  2) Introduction of MARTS in selected units
  3) Addition of new communications materiel
- Modification of the Division signal organization to accommodate:
  1) Introduction of the Division MARTS (i.e., replaces the Division multichannel system and selected radio nets)
  2) Addition of new communications materiel
- TOE changes to accommodate the introduction of new communications materiel into those units with organic tactical communications capability.

Salient features of Concept ECHO, in terms of communications capabilities for the multichannel and single channel communications systems, are summarized in the following paragraphs.

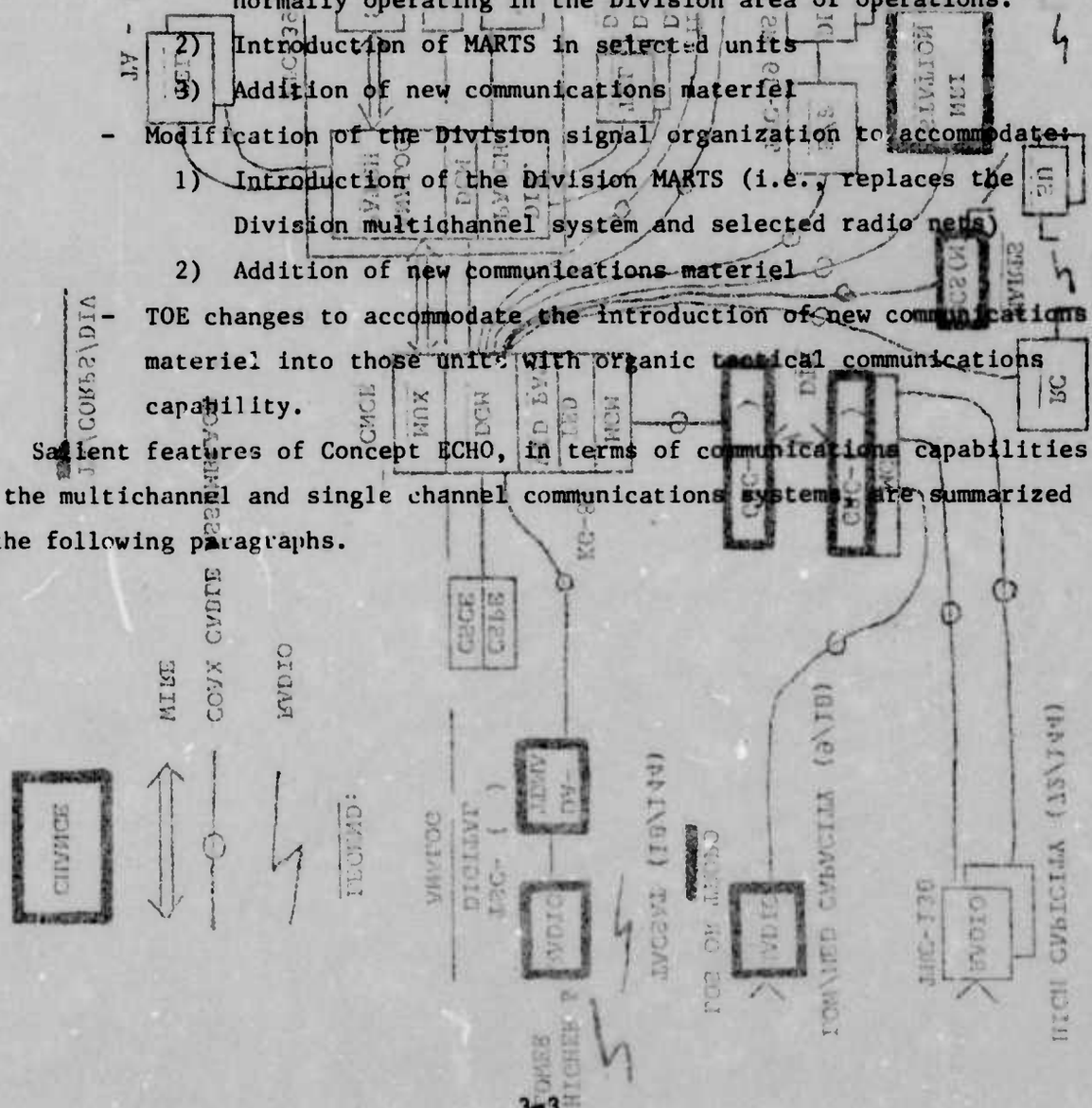


FIGURE 3-3 MULTICHANNEL AREA MODE ARRANGEMENT

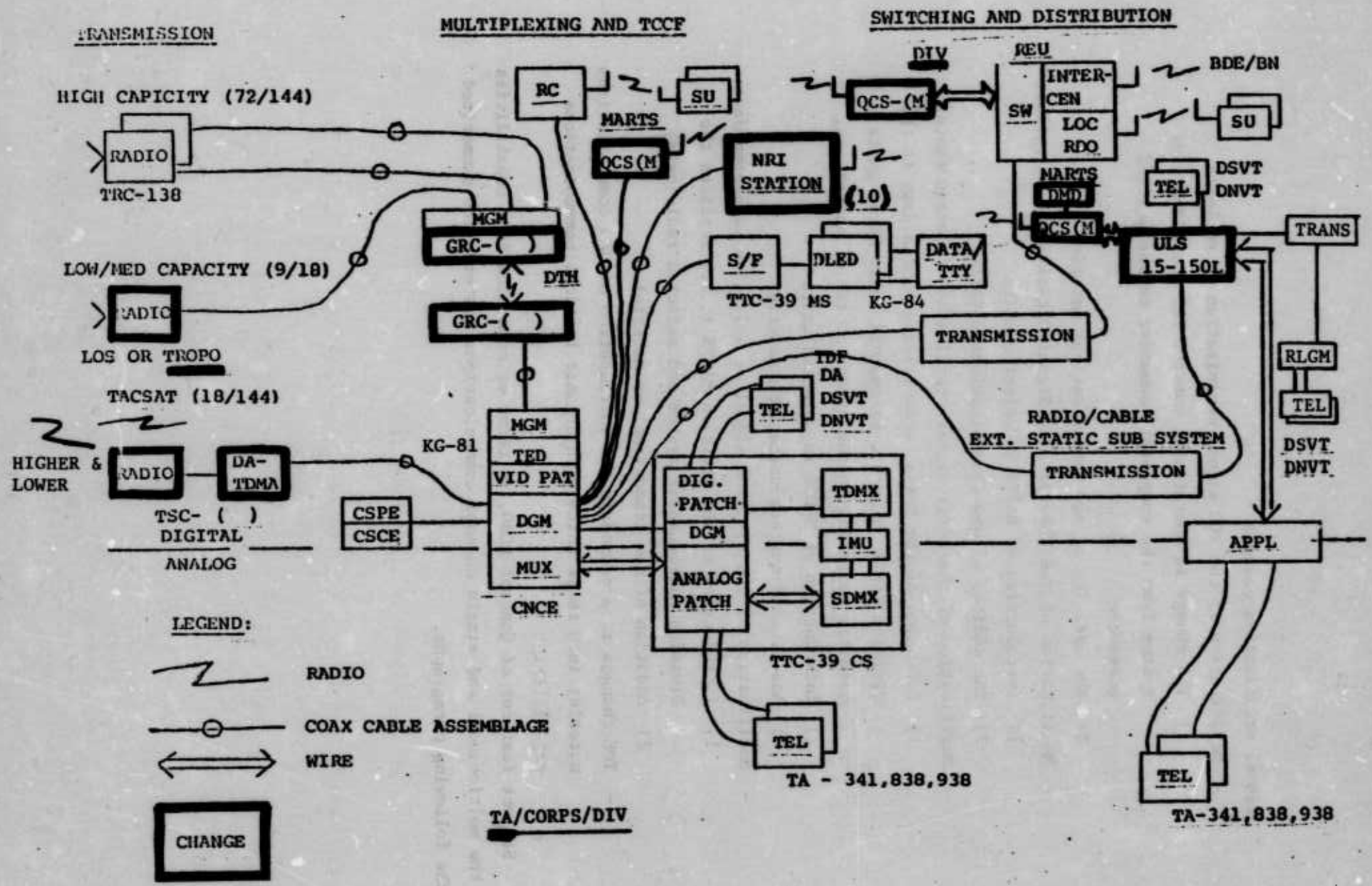


FIGURE 3-2 MULTICHANNEL MAJOR NODE FUNCTIONS - ECHO

3.1.1 Concept ECHO Major Multichannel Node Functions

ECHO introduces the TRITAC equipments into Theater Army, employs digital Tropo, DA TDMA TACSATCOM (unconstrained and requiring just one terminal for transmission to the higher and lower echelons), and the AN/GRC-( ) for down-the-hill transmission. ECHO also employs the automatic digital NRI station, option 10, the additional 15-line ULS, and MARTS in Division and in selected location in EAD as illustrated in figure 3-2.

The Query Control Station, QCS-(M), contains added memory and is considered as a communications asset for S/C interfacing and for record traffic handling. The Digital Message Device (DMD) is introduced as a QCS-(M) I/O device.

Only TENLEY and MARTS COMSEC devices are employed for multichannel. Loop COMSEC devices are allocated to satisfy all COMSR's without a percentage restriction. However, if cost constraints encountered during Task V prohibit the achievement of this goal, PACER priorities will be applied.

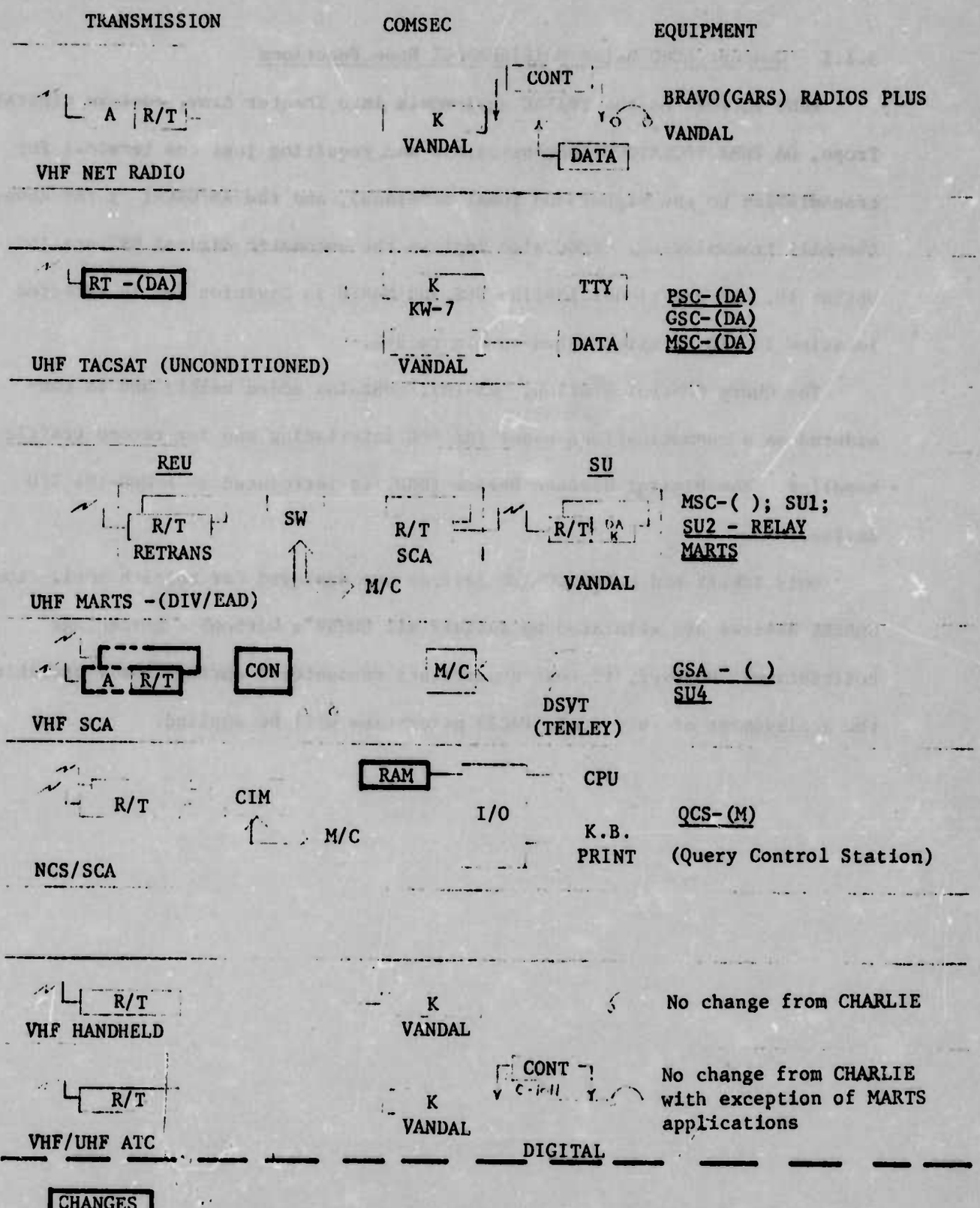


FIGURE 3-3 Single Channel Major Functions - ECHO

3.1.2 Single Channel Major Functions

Within Concept ECHO, DA TDMA TACSAT and MARTS technologies are introduced for usage at all echelons. Specific equipments introduced appear in figure 3-3 and are categorized by major single channel function. A discussion of these added equipments follows:

° VHF Transmission Facilities:

- No provision will be made for VHF retransmission facilities.
- ARWI implemented with secure automated TRITAC Option 10, and MARTS.

° Air Traffic Control Transmission Facilities:

- Selected applications of MARTS for ATC.

° TACSAT Transmission Facilities:

- DA TDMA S/C TACSAT introduced.
- Application of S/C TACSAT unconstrained.

° Mobile Automatic Radio Telephone System (MARTS) Facilities:

- Replaces switched-wire communications and administration/logistic nets within the division.
- Used for selected applications in the EAD.
- Equipments:

  . Subscriber Unit Two (SU2) delay-only provides user access to the REU for range extension or gaining accessing other communications facilities.

° Communications Interface Facilities (Modified):

- Communications interface facilities are provided by Query Control Station - QCS (M).
- Employs I/O and CPU for operational control.
- Random Access Memory (RAM) incorporated to permit automatic message processing.

° COMSEC through MARTS compatibility with TENLEY devices. All COMSR's requirements are satisfied for on-line and off-line security. However, if cost constraints encountered during Task V prohibit the achievement of this goal, PACER priorities will be applied.

Concept ECHO provides a digital transmission capability and facilitates secure transmission for all single channel major function shown in figure 3-3.

3.2 CONCEPTUAL EMPLOYMENT GUIDELINES

The scope of Concept ECHO requires an overall systematic approach in the identification of the various communications options and conceptual assets available to the tactical Army during the Mid-Range Time Frame (1976-1986). This section provides a broad estimate of the relative effectiveness areas for various candidate systems and provides the employment guidelines for MARTS and TDMA TACSATCOM.

The INTACS Task III developed various Measures of Effectiveness (MOE) to be used to evaluate the relative effectiveness among different MRTF candidate communications systems. Table 3-1 is a matrix of the Task III Effectiveness Areas and Aspects versus the functional areas of the candidate communications systems that form the Multichannel Transmission Facilities, Single Channel Transmission Facilities functions within the INTACS study framework. This table provides a means of evaluating the systems relative to each other for each area, e.g. the relative mobility effectiveness of a wire type system is poor when compared to the excellent effectiveness of an omnidirectional radio system such as VHF-FM net radio.

For Concept ECHO, it was concluded from table 3-1, that MARTS and DA TDMA TACSAT embody those effectiveness areas that will greatly enhance the communications system of the Army for the MRTF.

3.2.1 Rationale For Employment of MARTS

MARTS is comprised of a family of two types of subscriber units and a range extension unit. This communications capability permits the formulation of various types of integrated communications capabilities. The MARTS service area encompasses the Division and selected applications in the EAD. The most cost-effective mix of the available communications options is influenced greatly by the manner in which the various equipments are employed. To assure that each equipment may be used effectively, the following guidelines are presented for the employment of subscriber units and the range extension unit in Division and EAD:

% MOE	AREA	LOS M/C	Cable M/C	M/C KI SYSTEM (MKS)
11.4	1. QUALITY OF SERVICE a. GOS b. SOS c. Quality	Sizeable (Exc) N/A Excellent (LOS)	Sizeable (Exc) N/A Excellent	Sizeable (Exc) N/A Excellent
9.3	2. OPERABILITY a. Ease of Opns b. Service Features	MOS rqd Same as M/C	MOS rqd Same as M/C	MOS rqd N/A
12.9	3. RELIABILITY	Good	Fair	Excellent
8.4	4. MAINTAINABILITY a. PM b. Corr Maint c. Software Maint	Good	Fair	Excellent
5.0	5. EMC/EMV	Good	Superior	Excellent
7.9	6. LOG SPT a. Ease of Parts Spt b. Power Reqts	Good 3-10kw/shelter	Good 3-10kw/shelter	Excellent 3kw/shelter
7.1	7. SECURITY	Total for link available	Total for link available	Total for link available
9.5	8. FLEXIBILITY a. Changes in Msn,Envir,Force b. Changes in Commo Needs c. Deployment/Displacement	Good	Poor	Good
7.5	9. MOBILITY a. Set Up/Tear Down Time b. Commo Ability During Moves	Fair	Poor	Good
4.6	10. TRANSPORTABILITY a. Veh Reqts Organic for Commo b. Portability	5/4&2½ rqd	5/4&2½ rqd	5/4 rqd
4.1	11. RF SPECTRUM	Fair	Superior	Fair
3.9	12. STANDARDIZATION	Fair	Fair	Good
4.7	13. SURVIVABILITY a. Physical b. EW	Fair	Good Superior	Good
3.9	14. VULNERABILITY a. Physical b. EW	Fair	Excellent Superior	Good

2

TABLE 3-1 Concept ECHO Effectiveness Areas and Aspects v

M/C KE SYSTEM (MKS)	TROPO M/H	FDMA TACSAT M/C	DA TDMA TACSAT (POTENTIAL)	MARTS SU1 (POTENTIAL)	MARTS SU2 (POTENTIAL)	MIRE (W/A
Sizeable (Exc) N/A Excellent	Sizeable (Exc) N/A Good (Fades)	Sizeable (Exc) N/A Excellent	Sizeable (Exc) N/A Excellent	Dynamic (Exc) 8 sec average Excellent	Dynamic (Exc) 8 sec average Excellent	Size ave= Exce
MOS rqd N/A	MOS rqd Same as M/C	MOS rqd Same as M/C	MOS rqd Same as M/C	User OJT/RelayMOS Fixed Directory	User OJT/RelayMOS Fixed Directory	User TCCF Direc
Excellent	Fair	Excellent	Excellent	Excellent	Excellent	Good (Wire
Excellent	Fair	Excellent	Excellent	Excellent	Excellent	Good
Excellent	Poor	Excellent	Superior	Excellent	Superior	Super wire
Excellent 3kw/shelter	Fair 15kw/terminal	Good 10kw/terminal	Good 10kw/terminal	Excellent 10kw/relay SU fm prime mover	Excellent 10kw/relay SU fm prime Mover	Excel 3-5kw Term
Total for link available	Total for link available	Total for link available	Total for link available	Total	Total	Secur
Good	Fair	Excellent	Superior	Superior	Fair	Poor
Good	Poor	Good	Good	Excellent	Excellent	Poor
5/4 rqd	5/4&2½ rqd	5/4 rqd	5/4 rqd	5/4 relay rqd SU on prime mover	5/4 relay rqd SU on prime mover	5/4&2 Term carr
Fair	Poor	Excellent	Excellent	Excellent	Excellent	Super wire
Good	Fair	Good	Good	Excellent	Excellent	Excel
Good	Fair	Good (Excellent w/ ECCM)	Good (Exc-ECCM)	Good (Exc w/ECCM)	Good (Exc w/ECCM)	Super wire
Good	Fair	Good (Excellent w/ ECCM)	Good (Exc-ECCM)	Good (Exc w/ECCM)	Good (Exc w/ECCM)	Super wire

nd Aspects vs Communication Functions

	WIRED TERM SET (W/AUTO SWBD)	ARWI	RWI	VHF Net Radio	HF Net Radio	HANDHELD Net Radio	SC FDMA TACSAT
)	Sizeable (Exc) ave=1 to 5 sec Exeellent	Good ave=30 sec Excellent	Fair ave=60 sec Excellent	Good ave=1 sec Excellent	Fair ave=1 sec Poor	Good ave=½sec Good	Good ave=2sec Excellent
yMOS ory	User OJT, Swbd MOS TCCF MOS Directory Variable	User OJT, SOI rqd	User OJT Opr MOS SOI rqd	User OJT SOI rqd	User MOS SOI rqd	User OJT No SOI Only SOPs	OJT & MOS SOI rqd
	Good (Wire Damage)	Good	Fair	Excellent	Poor	Fair	Excellent
	Good	Good	Good	Excellent	Good	Fair	Excellent
	Superior w/ wire only	Good	Good	FAIR	Good	Excellent	Good
Mover	Excellent 3-5kw/swbd shelter Term Set=low power	Good low power	Good low power	Excellent low power	Good 3kw/RATT med power	Fair very low power	Good low power
	Secur able	Difficult but securable	Very difficult but securable	Securable	Total for RATT Voice fair	Securable w/ sizeable penalty	Securable
	Poor	Good	Fair	Good	Good	Poor	Excellent
	Poor	Fair	Fair	Excellent	Good	Excellent	Excellent
d mover	5/4&2½ Swbd Term set=hand carry	no extra veh rqd w/ retrans	no extra veh rqd w/ retrans	org prime mover for retrans (air/gnd)	5/4 for RATT otherwise prime mover (air/gnd)	User carry	5/4 RATT, prime mover for voice
	Superior w/ wire only	Good	Good	FAIR	Excellent	Good	Good for Vo Excellent f data
	Excellent	Good	Good	Excellent	Good	Poor	Good
)	Superior w/ wire only	Good (exc w/ECCM)	Good (Exc w/ECCM)	Good (Exc w/ECCM)	Fair	Good	Good (Exc w/ECCM
)	Superior w/ wire only	Good (Exc w/ECCM)	Good (Exc w/ECCM)	Good (Exc w/ECCM)	Poor	Good	Good (Exc w/ECCM

) Net	SC FDMA TACSAT	SC TDMA TACSAT	ATC Net Radio	Area Reference within Task III (Page #)
	Good ave=2sec Excellent	Excellent ave= 4sec Excellent	Good ave=1sec Good	A-4
? ?s	OJT & MOS SOI rqd	OJT & MOS fixed SOI	OJT Semifixed SOI &SOPs	A-38
	Excellent	Excellent	Good	A-27
	Excellent	Excellent	Good	A-41
nt	Good	Excellent	Good	A-46
w	Good low power	Good low power	Good acft power	A-30
le w/	Securable	Securable	Non-secure SOPs	A-32
	Excellent	Superior	Mission oriented	A-18
nt	Excellent	Excellent	Excellent	A-7
rry	5/4 RATT, prime mover for voice	5/4 RATT, prime mover for voice	acft and veh prime movers	A-9
	Good for Voice Excellent for data	Good for Voice Excellent for data	Good	A-45
	Good	Good	Good	A-40
	Good (Exc w/ECCM)	Good (Exc w/ECCM)	Fair	A-16
	Good (Exc w/ECCM)	Good (Exc w/ECCM)	Fair	A-11

- User requirement for high mobility
- Requirement for communications system fast setup and teardown times
- Suitability of MARTS to satisfy characteristics of deployment for various type users (especially in Corps and Theater Army)
- Improved quality of communications by application of MARTS
- Impact of MARTS on personnel and vehicle requirements
- Interface requirements of MARTS. MARTS operational capabilities are compatible with ATACS and MARTS is the mobile subscriber communications element of the Mobile Subscriber Access Subsystem (outlined in the TRITAC Subsystem Plan, November 1973).
- Potential refinements of MARTS to maximize its responsiveness to requirements peculiar to EAD units, such as wide geographical separation
- Potential ECCM capability,

3.2.2 Rationale for Employment of Satellite

3.2.2.1 TACSATCOM General

TACSATCOM facilities should be considered as a replacement for Concept BRAVO Systems where the following conditions are encountered:

- User requirements for reliable, high grade communications among units or forces at extended communications distances and/or in difficult communications terrain. (Area = Quality of Service and Reliability.)
- Requirement for communication system with fast set up and tear down times. (Area = Mobility.)
- Requirement for communications to support rapid changes in mission, environment, and force structure. (Area = Flexibility.)

3.2.2.2 DA TDMA TACSATCOM

DA TDMA TACSATCOM provides several advantages over the Preassigned Frequency Division Multiple Access (PA FDMA) TACSATCOM employed in Concepts BRAVO and CHARLIE. (Although the use of TACSAT is unconstrained in Concepts CHARLIE and ECHO, it may become necessary in Task V to impose constraints because of limited resources.) These advantages include:

- Increased system capacity for the same segment capability and RF spectrum.
- Reduced prorated space segment costs per call.
- Enhanced deployment flexibility of supported users.
- Reduction in number of TACSATCOM terminals required per node.
- Increased system connection and sizing flexibility.
- Reduction in system planning, engineering and control requirements and complexity.
- Potential Warning broadcast capability.

- Efficient data transfer capability for tactical data systems. DA TDMA TACSATCOM includes both single and multichannel TACSATCOM systems. DA TDMA TACSATCOM will be employed in Concept ECHO in lieu of PA FDMA TACSATCOM employed in Concepts BRAVO and CHARLIE. In addition, an examination will be made of all additional potentially cost effective applications for DA TDMA TACSATCOM within a Division and the EAD. All applications identified will then be optimized and trade off analyses will be conducted comparing the cost effectiveness of DA TDMA TACSATCOM to other communication approaches.

Potential problem areas which must be considered in defining and evaluating the employment of DA TDMA TACSATCOM include the following:

- System ECCM Requirements. At first glance, the ability of DA TDMA TACSAT to support critical user requirements would encourage that this type system should be the primary and perhaps only transmission means within Concept ECHO. The space segment channel saturation limitations encountered with FDMA TACSAT have been greatly reduced with DA TDMA TACSAT. However, the restricted use of FDMA TACSATCOM forced it into the role of an alternative means to the primary terrestrial systems. Neutralization by EW or physical means of the FDMA TACSATCOM would reduce the overall communications posture of the total system but it would not prove to be totally disruptive. The use of DA TDMA TACSAT as a primary means would provide a lucrative target for a potential threat via EW or physical destruction means. The degree of vulnerability from threat neutralization inherent with DA TDMA TACSATCOM must proportionally limit its use to a secondary communications means. The level and extent of ECCM capability required for DA TDMA TACSATCOM will be identified and evaluated during INTACS Task V. In view of this

problem area, the DA TDMA TACSATCOM system will be sized to support high precedence traffic only (not to a fixed percentage of all user traffic at a node) while the terrestrial primary system will be sized to support all routine traffic loading.

- Transitional Interface. DA TDMA TACSATCOM is intended to use the TRITAC architecture to include the use of 32 kbps/voice channel. During the transitional period prior to full TRITAC System employment, the need will exist for a 32 kbps/voice channel multiplexer to interface analog switchboards/subscribers with the DA TDMA TACSATCOM terminals.
- System Management. Military communications satellites are considered to be national assets and overall control is maintained by the JCS. Joint utilization of any TACSATCOM space segment is visualized with Theater control of the capability maintained by the unified commander. As such, consideration must be given to the impact of potential preemption of some or all of the TACSATCOM space segment capacity allocated to Army units.
- Segment Costs. An estimate of the cost for a complete 4-satellite system (approx. 384 SHF and 32 UHF channels per satellite) was included in the DA sponsored "Ground Mobile Forces Satellite Communications Program Memorandum" approved by the Sep Sec Def on 31 Jan 74. The estimated costs for the period of 1974-1982 are:

R&D	-	$ 45.5M
PEMA	-	122.2M
O&M	-	3.9M
Total		$171.6M

The TACSATCOM Study, Appendix F, Annex II will be used for space segment cost guidance in Task V.

3.3 POTENTIAL REDUCTIONS

The employment of Concept ECHO may result in significant reductions as compared with Concepts ALPHA, BRAVO, and CHARLIE. These estimated reductions described in the following paragraphs are based on a preliminary Task IV analysis, are simply to provide an indication of ECHO's potential, and are subject to adjustments in Task V.

3.3.1 DA TDMA TACSATCOM

The employment of DA TDMA TACSAT terminals in Concept ECHO should result in potential equipment and personnel savings at all echelons as compared to the use of LOS/Tropo/single channel/wire systems in Concept ALPHA and the mix of these and FDMA TACSAT in Concepts BRAVO and CHARLIE. The higher efficiency of demand assignment TACSAT increases the capacity of the satellite communications medium over the preassigned FDMA system, permits more flexible use of available channels to users of the media, and replaces the need for repeaters and large number of O&M personnel inherent in terrestrial LOS/Tropo/single channel/wire systems. The use of DA TDMA TACSAT potentially reduces the number of terminals required over that needed for FDMA TACSAT and LOS/Tropo systems. (For example, each node may require only one TDMA terminal per node in lieu of two or more FDMA terminals.) Concept ECHO employs DA TDMA TACSAT organic to the signal unit supporting the Division (to include subordinate Brigades), the Corps (to include the Separate Brigade), and the Theater Army. By Concept, DA TDMA TACSAT potentially replaces the following multichannel systems:

	ALPHA	BRAVO/CHARLIE
Division	- TRC-113, TRC-145 cable Div M/C Sys	Same as ALPHA
Corps	- TRC-112, TRC-117, TRC-121 Cmd Sys	FDMA TACSAT Cmd Sys
TA	- TRC-112, TRC-138 Cmd & Area Sys	FDMA TACSAT Cmd Sys
	ADA TRC-113, TRC-145	TRC-112's at 4 area nodes

3.3.2 Mobile Automatic Radio Telephone System

The application of MARTS in the Division, within certain candidate units at Corps and Theater Army, as well as in the Separate and Divisional Brigades first introduced in Concept CHARLIE will not only better satisfy user requirements, but will result in higher mobility for the tactical unit and a potential reduction in communications support personnel. MARTS, together with a family of next generation SINCGARS net radios to maximize equipment modularity and commonality, will provide an integrated radio system for the user, will greatly improve CP displacement time, and will dispense with the use of all wire systems except for internal CP security purposes.

3.3.3 Potential Communications Support Personnel Savings

An estimate of communications/personnel requirements by echelon for each concept is shown below. Potential savings in personnel are possible through the employment of DA TDMA TACSAT and MARTS in Concept ECHO.

	ALPHA	BRAVO	CHARLIE	ECHO	ECHO SAVINGS vs. ALPHA
1 Sep Bde	Comm Plt 53 pers	Sig Co 110 pers	Comm Plt 52 pers	Comm Plt 50 pers	3 pers
5 Div	Sig Bn 3080 pers	Sig Bn* 3750 pers	Sig Bn 3200 pers	Sig Co 1500 pers	1580 pers
1 Corps	Sig Bde 5660 pers	Sig Gp 1800 pers	Sig Gp 2350 pers	Sig Bde 5060 pers	600 pers
1 TA	TACC/TASCOM/ ADA 22,000 pers	Same 26,000 pers	Same 21,300 pers (fluid)	USACC/TASCOM/ ADA 14,500 pers	7500 pers
TOTAL INTACS FORCE MODEL	30,793 pers	31,660 pers	26,902 pers	21,110 pers	9683 pers

* - Includes expanded Brigade and DIVARTY communications platoons for added multichannel systems - AN/TRC-(VDT)

3.3.4 Potential Equipment Reductions

Potential reductions in signal equipment are estimated as follows:

° DA TDMA TACSAT may replace:

Division: ALPHA TRC-113/145 equipment and BRAVO/CHARLIE MSC-59 terminals in the Division multichannel system.

Corps: Previous concept LOS/Tropo/FDMA TACSAT command multichannel links. Sufficient LOS/cable systems retained for user-to-user interconnectivity. 16 Corps Area nodes envisioned in ECHO employing LOS/Tropo.

TA: All heavy Tropo, ADA TRC-145/113 systems to battalion level, and approximately 12 light Tropo terminals in Concept ALPHA. Replaces FDMA TACSAT terminals in Concepts BRAVO and CHARLIE.

° MARTS may replace:

Sep Bde: 4 admin-log radio nets, 300-plus field telephones, over 400 miles of field wire, 2 TTC-29, 3 SB-86, and 40 SB-22.

Division: Reduction of net radios by about 10 percent and 60 switchboards, 6 RWI stations, over 1000 field telephones, 900 miles of field wire and cable, and 40 LOS multichannel TRC-145/113 terminals. MARTS will employ 15 REU's plus subscriber units to replace the Division LOS multichannel system.

Corps: EAD application at Corps MAIN, TAC, COSCOM plus FA, ADA, ASA, ASA, ACR, Engr, Chem, MP, Ord, Aviation, and Trans units will reduce TOE net radios by approximately 10 percent plus over 200 switchboards, 2000 telephones, and 2500 miles of field wire.

TA: EAD application in Theater Army Pershing, and ACR units will reduce TOE net radios by about 10 percent plus 60 switchboards, 1000 telephones, and 1200 miles of field wire.

° Single channel DA TDMA TACSAT replaces:

- HF radio formerly employed in TA and Corps Command and Fire Direction Nets to result in approximately a 40 percent reduction of radio terminal equipments with no loss in capability.
- FDMA TACSAT employed in support of SAS requirements to increase flexibility of operation.

° Based upon a comparison of the Division multichannel system in Concept ECHO vs ALPHA, it is estimated that a 1/3 reduction in weight, or 20 tons, is achieved by the employment of DA TDMA TACSAT and MARTS to replace LOS multichannel, manual switching, and wire.

3.3.5 Training Implications

Substantial reductions for training in field wiremen, multichannel equipment operators, and manual telephone switchboard operators are envisioned due to the employment of MARTS, DA TDMA TACSAT, and automatic switching. Some reduction of officers and radio/radio teletypewriter operators due to Division MARTS, single channel TACSAT, and new family of subscriber units application is also forecast.

There is a tradeoff in the requirement for higher enlisted skills to operate and maintain increased quantities of automatic/sophisticated equipment.

Based on an FY 74 USASIGS enrollment of over 17,000 officers and EM, an annual decrease of approximately 5,000 is estimated.

4.0 CONCEPT ECHO FOR SEPARATE BRIGADE

The Mobile Automatic Radio Telephone System (MARTS), which was introduced in Concept CHARLIE, is continued in Concept ECHO. This system is compatible with the Division MARTS in the Force Model deployment. MARTS performs the functions of multichannel systems and selected functions of a single channel system. Multichannel communications functions performed by MARTS are: multichannel transmissions; switching; technical, facilities, and system control. Single channel access to the system is provided. MARTS is the mobile subscriber element of TRITAC. Within this concept, Demand Assigned Time Division Multiple Access (DA TDMA) TACSAT will be utilized for communications to the next higher echelon. The communications materiel for this concept is the same as for Concept CHARLIE with DA TDMA TACSAT replacing the Frequency Division Multiple Access (FDMA) TACSAT.

A description of Separate Brigade Concept ECHO in terms of doctrine, signal organization, and communications materiel appears in subsequent paragraphs of this section.

4.1 COMMUNICATIONS SYSTEM DESCRIPTION

The communications Concept ECHO is based on the same organizational and operational concept and area of operations as specified by Separate Brigade Concept ALPHA. The MARTS, introduced in Concept CHARLIE, is deployed in Concept ECHO. (See figure 4-1.) The Separate Brigade system will employ primarily MARTS and DA TDMA multichannel TACSAT, with backup provided by net radio and /or single channel TACSAT terminals deployed within the Separate Brigade area.

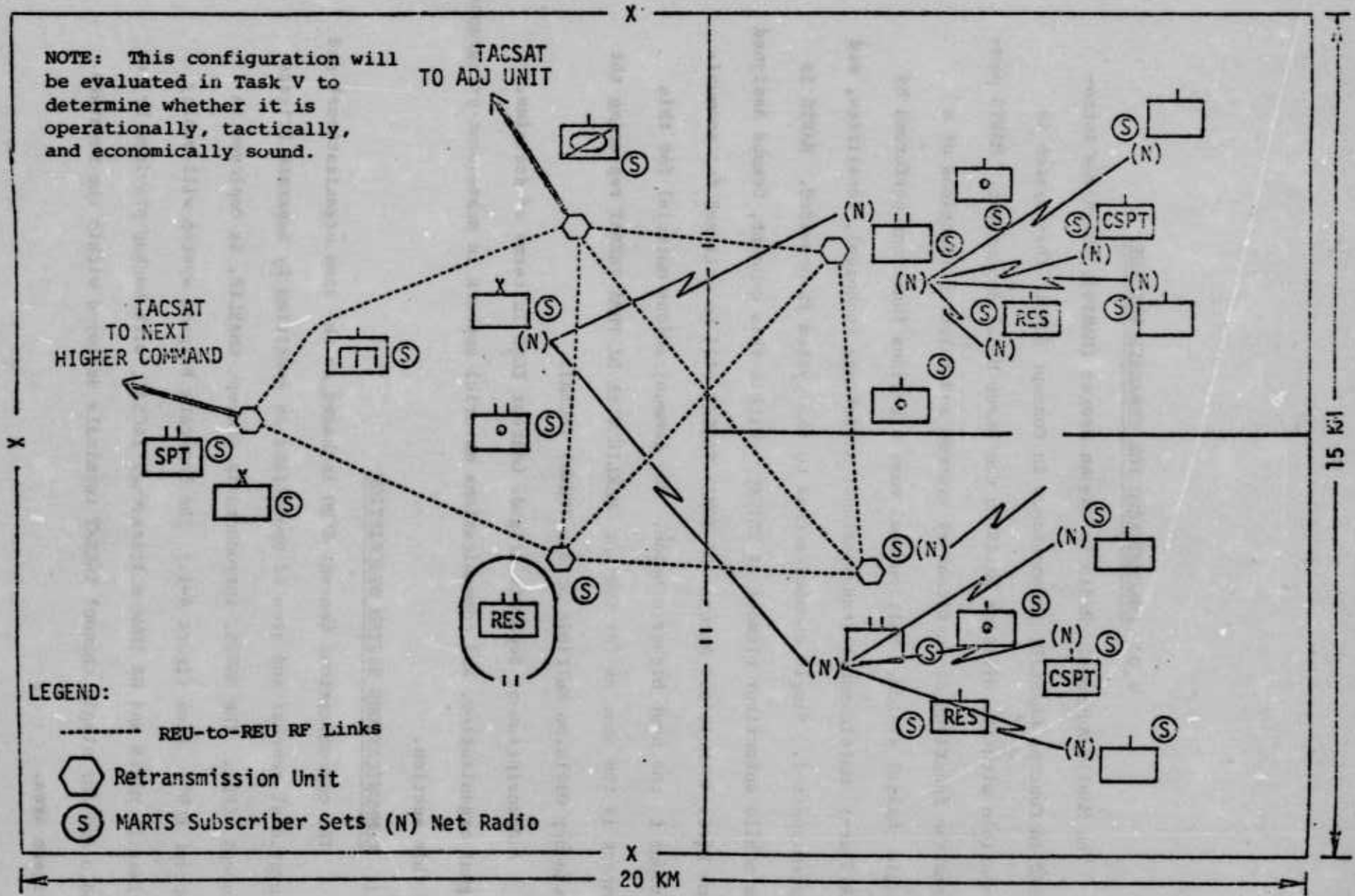


FIGURE 4-1 Concept ECHO MARTS for Separate Brigade

4.2 COMMUNICATIONS FUNCTIONS AND EQUIPMENT

The communications equipment for Concept CHARLIE and Concept ECHO are greatly reduced from previous concepts. Capabilities inherent in the MARTS equipment will either perform functions of other equipment or eliminate the need for certain equipment. Requirements for Concept ECHO are as follows:

- Multichannel Transmission

  Functions will be performed by MARTS REU-to-REU transmissions.

- Switching

  Functions will be performed by automaticity of the MARTS Range Extension Units and the Subscriber Units. The SB-993 will be retained for perimeter defense functions.

- TCCF

  Functions will be performed by the inherent capabilities of the MARTS Range Extension Units and Subscriber Units.

- Single Channel Access

  Inherent to MARTS, with the MARTS/option interface providing access for tactical net radio users.

- Single Channel Transmission

  VHF/UHF and PRC-68 same as Concept CHARLIE

  MARTS Subscriber Unit

  MARTS/SINCTRAC Radio Set, Automatic

  MARTS/SINCTRAC Radio Set, Semiautomatic

  MARTS/SINCTRAC Radio Set, Manual

  DA TACSAT UHF Terminal, Manpack

DA TACSAT UHF Terminal, 1/4-ton

DA TACSAT UHF Terminal, 1 1/4-ton

DA TACSAT UHF Receiver/Transmitter

- Telecommunications Centers

  Concept CHARLIE assets plus an improved Query Control Station (QCS-(M)) and the Digital Message Device (DMD).

- Wire and Cable

  Eliminated, except for perimeter defense

- Command Post communications

  Requirements satisfied by MARTS

- COMSEC

  Inherent to MARTS/SINCTRAC; MARTS optimized for TENLEY.

- Terminal Equipment

  I/O devices, TTY and facsimile equipment of Concept CHARLIE plus QCS-(M) and DMD.

4.3 COMMUNICATIONS DOCTRINE

- The communications doctrine in Candidate ECHO for the Separate Brigade will be identified in terms of MARTS as employed under Concept CHARLIE, plus an extended application of a family of MARTS subscriber units and SINCTRAC units which maximize equipment commonality and modularity. Concept ECHO MARTS is designed to replace the Separate Brigade switched-wire or LOS multichannel systems deployed in Candidate ALPHA and BRAVO, as well as to introduce a family of single channel net radios for a fully integrated concept.

- If the MARTS concept is found to be cost effective for employment, a new doctrinal field manual will be required for the Separate Brigade communications.

4.4 SIGNAL ORGANIZATION

A completely revised communications organization and new TOE 7-102 for the HHC, Separate Brigade, will be required for the allocation of MARTS subscriber units/SINCTRAC units and the installation, operation, and maintenance of MARTS Range Extension Units. Current TOE switched-wire system, RWI, and FM radio assets will be deleted accordingly.

5.0 CONCEPT ECHO FOR DIVISIONS

Division Concept ECHO introduces a Division Mobile Automatic Radio Telephone System (MARTS) as a replacement communications system for the Division multichannel communications system. MARTS, through its inherent automated traffic handling, routing, and self-test and control capabilities, provides communications facilities equal to those communications facilities of a multichannel communications system. The multichannel communications functions performed by MARTS are: multichannel transmission; switching; technical, facilities, and control functions of TCCF; single channel access; and a secure digital terminal (MARTS digital handset). In addition, MARTS provides the Division with a highly mobile, secure communications capability that satisfies the divisions command and control, plus area communications support requirements. The communication materiels of Concept ECHO also include the new DA TDMA TACSAT, automated SCA, option 10, and the QCS-(M). VHF/FM single channel facilities of Concept BRAVO are retained along with the handheld radio from Concept CHARLIE. HF/SSB facilities are not used.

A description of Concept ECHO in terms of doctrine, signal organization and communications materiel appears in subsequent paragraphs of this section.

5.1 COMMUNICATIONS SYSTEM DESCRIPTION

Division communications Concept ECHO is based on the same Division organizational and operational concept and area of operations as specified in Concept ALPHA. (See figure 5-1.) In Concept ECHO, a Division Mobile Automatic

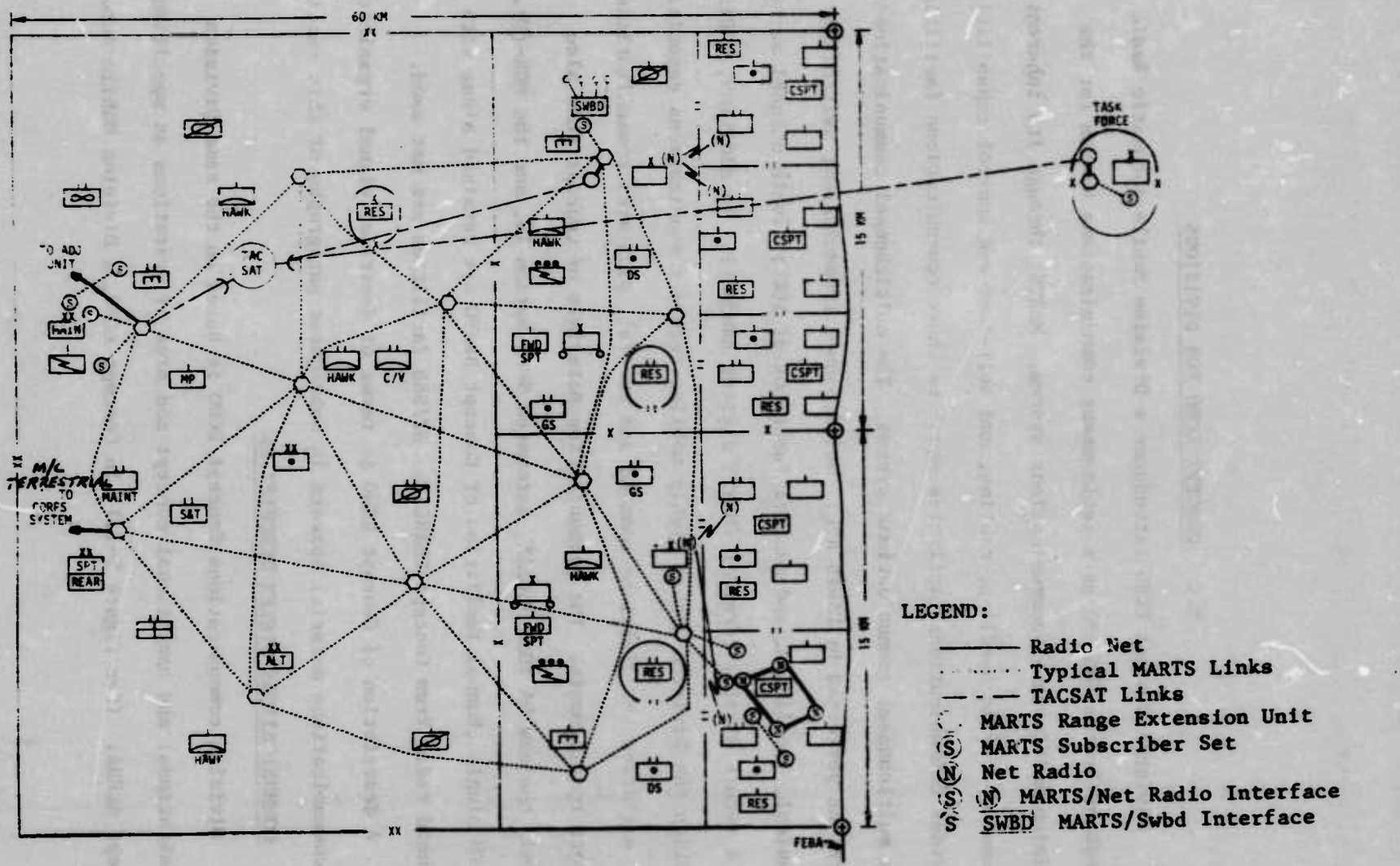


FIGURE 5-1 Concept ECHO Division Command System

Radio Telephone System (MARTS) will be introduced as a replacement for the current Division multichannel switched-wire communications system. It will provide the present switched-wire and administrative/logistics net radio users with a mobile, secure communications capability for voice, data, teletypewriter, and facsimile traffic. Additionally, certain secure VHF/FM radio Admin/Log nets will be eliminated. DA TDMA TACSAT will be employed to interconnect the MARTS range extension unit (REU) with higher echelons, with other REU's, and with forces operating remotely to the Division combat area. The Division system will employ primarily MARTS and DA TDMA multichannel TACSAT, with back-up provided by net radio and/or single channel TACSAT terminals deployed within the Division area.

5.2 COMMUNICATIONS FUNCTIONS AND EQUIPMENT

The communications functions and equipments for Concept ECHO are greatly reduced over other concepts, in that capabilities inherent in the MARTS equipments will either perform these functions or eliminate the need for certain equipments. Requirements for Concept ECHO are presented as follows:

- Multichannel transmission - Functions will be performed by MARTS REU-to-REU transmission. Potential application of DA TDMA multichannel TACSAT for REU-to-REU and REU to higher echelons.
- Switching - Functions will be performed by automatic call placement capability for SU-to-SU, SU-to-REU, REU-to-SU, REU-to-REU, and REU-to-interface. A low capacity, automatic switch may be employed for remote user MARTS access with manual switched wire retained for perimeter defense functions.

- TCCF - Functions will be performed by the inherent capabilities of the MARTS REU and SU. The data/TTY technical control facility will be retained.
- Single-channel access - Inherent to MARTS, with MARTS/ARWI interface providing access for tactical net radio users, automatic option 10, and QCS-(M).
- Single-channel transmission -

  VHF/UHF ATC - Same as Concept CHARLIE

  MARTS Subscriber Unit

  MARTS/SINCTRAC Radio Set, Automatic

  MARTS/SINCTRAC Radio Set, Semiautomatic

  MARTS/SINCTRAC Radio Set, Manual

  DA TACSAT UHF Terminal, Manpack

  DA TACSAT UHF Terminal, 1/4-ton

  DA TACSAT UHF Terminal, 1 1/4-ton

  DA TACSAT UHF Receiver/Transmitter
- Telecommunications centers - Concept CHARLIE assets plus QCS-(M) and DMD
- Wire and cable systems - Except for perimeter defense, this requirement will be eliminated.
- Command Post Communications - Requirements will be satisfied by MARTS
- COMSEC - Inherent to MARTS, optimized for TENLEY
- Terminal equipments - I/O devices, TTY, and facsimile equipments of Concept CHARLIE plus QCS-(M) and DMD.

5.3 COMMUNICATIONS DOCTRINE

- The introduction of MARTS, DA TDMA TACSATCOM, and other TRITAC equipment into the AIM Division under Concept ECHO will necessitate a complete revision of FM 11-50 and other literature pertaining to communications in the Division and combat Brigades. MARTS/SINCTRAC units in conjunction with TACSAT will potentially replace the current Division LOS/cable multichannel system, Brigade and battalion switched-wire networks, and the current family of FM radios and RWI facilities.
- Based upon the final system design, new doctrinal literature will be required for communications in the AIM Division and subordinate Brigades.

5.4 SIGNAL ORGANIZATION

The Division MARTS, DA TDMA TACSAT, and other TRITAC equipments application in Concept ECHO will require a completely new signal organization and concept for the current Division Signal Battalion, TOE 11-35 series. The economy of operation inherent in both MARTS and TACSAT, as compared to LOS and switched-wire systems, will appear to substantially reduce the communications support organization under Concept ECHO for the AIM Division.

6.0 CONCEPT ECHO FOR EAD

Concept ECHO for EAD differs from Concept ALPHA by the fact that the signal organization of the unified or combined commander installs, operates, and maintains the Theater command system and the COMMZ area system. The Theater area system serves all joint and Service Component needs in the COMMZ, and encompasses the formerly described Theater Army area system. The Theater Army signal organization installs, operates, and maintains the Theater Army command communications system. Responsibility for Corps communications is vested with the Corps Signal Brigade. Communications materiel for this concept is the same as that identified in Concept CHARLIE for EAD with the introduction of DA TDMA TACSAT, tactical digital TROPO, and MARTS.

The use of MARTS communications facilities by certain combat, combat support, and, possibly, combat service support units in the Corps and Theater Army, will improve the effectiveness of their communications, be more responsive to their mobility requirements, and provide greater compatibility of communications between the Division systems and those Corps elements normally deployed in and supporting the Division. This is particularly true of the Corps Artillery units and the Corps Engineer units.

The units that have been selected for evaluation (as a minimum) are identified in table 6-1.

Theater Army units included on the attached list are identified as follows:

1 Armored Cav Regiment and its subordinate units -

The Pershing Brigade

2 Aviation Groups and their subordiante units

All of the listed Medical units

All other units belong to Corps.

TABLE 6-1

EAD MARTS CANDIDATE UNITS

COMSR TUN	TOE	EA	UNIT
AIR DEFENSE ARTILLERY:			
861	44-726	1	ADA BN C/V (CORPS)
852	44-328	2	ADA BTRY (CHAP)(SP)
862	44-727	2	ADA BTRY (VULC)(T)
ARMOR:			
554/590	17-52	2	ARMORED CAV REGT
642	21-1	2	TACP, ACR
594/557	17-58	2	AIR CAV TRP, ACR
591/555	17-56	6	CAV SQDN, ACR
592/556	17-57	18	CAV TRP, ACR
593/549	17-27	6	TANK CO, ACR
156/151	6-37	6	FA BTRY 155 (SP)
ARMY SECURITY AGENCY:			
806	32-56	1	ASA BN (CORPS)
807	32-57	1	ASA CO (DIV)
796	32-57	2	ASA CO (DIV)
797	32-57	2	ASA CO (DIV)
802	32-64	1	ASA CO (SEP BDE)
809	32-64	2	ASA CO (ACR)
811	32-067	1	ASA CO (OPNS)(A)
812	32-077	1	ASA CO (PROC)
808	32-059	1	ASA CO (AVN)

TABLE 6-1 (CONT)

EAD MARTS CANDIDATE UNITS

COMSR TUN	TOE	EA	UNIT
CORPS ARTILLERY:			
174	6-501	1	CORPS ARTY
170	6-401	2	FA GP
177	6-596	3	FA BN (LANCE)
178	6-597	9	FA BTRY (LANCE)
179	6-599	3	FA SVC BTRY (LANCE)
171	6-446	5	FA BN 8" (SP)
172	6-447	15	FA BTRY 8" (SP)
173	6-449	5	FA BTRY SVC 8" (SP)
195	6-456	2	FA BN 155 SP
196	6-459	2	FA SVC BTRY 155 (SP)
197	6-457	6	FA BTRY 155 (SP)
175	6-576	1	FA BN TGT ACQUISITION
176	6-577	3	FA BTRY TGT ACQUISITION
194	6-558	1	FA BTRY (SRCHLT)
193	6-604	1	PERSHING BDE
180	6-616	2	ARTY BN (PERSH)
181	6-617	8	ARTY BTRY (PERSH)
182	6-619	2	ARTY SVC BTRY (PERSH)
241	7-46	1	MECH INF BN (PERSH)
AVIATION:			
004	1-252	2	AVN GP
028	1-252	1	AVN GP
005/039	1-256	7	AVN BN
006/954	1-259	4	AVN CO (HVY)
007	1-258	5	AVN CO (MED)
008/040	1-258	4	AVN CO (ASLT SPT)
009	1-407	5	AVN CO
021	1-137	2	AVN CO
023	1-128	3	AVN CO (SURV)
249/275	7-357	8	AVN CO (ASLT HELD)
542/583	17-111	11	AVN CO (ATK HELD)

TABLE 6-1 (Cont)

EAD MARTS CANDIDATE UNITS

COMSR TUN	TOE	EA	UNIT
CHEMICAL:			
058	3-500	4	CML DET (CBRE)
066	3-266	1	CML BN (SMK GEN)
062	3-357	4	CML CO, MECH FLAME
ENGINEER:			
113	5-101	1	ENGR BDE
101	5-327	1	ENGR CO (TOPO)
078	5-124	1	ENGR CO (DPTK)
122	5-570	1	ENGR PLT (ADM)
102	5-52	2	ENGR GP (CBT)
110	5-58	1	ENGR CO (LT EQP)
105	5-36	4	ENGR BN (CBT)
107	5-37	16	ENGR CO (CBT)
108	5-64	1	ENGR CO (MBL ASLT BRG)
111	5-77	2	ENGR CO (PNL BRG)
112	5-78	2	ENGR CO (FLT BRG)
HEADQUARTERS:			
877	52-1	1	CORPS MAIN & TAC
MEDICAL:			
305	8-127	14	MED CO (AMBL)
320	8-137	1	AIR AMBL CO
310	8-660 (RA)	13	AIR AMBL DET
311	8-660 (RC)	3	AIR RESCUE DET
MILITARY INTELLIGENCE:			
773	30-17	1	CBT INTEL CO
771	30-17	2	CBT INTEL CO
780	30-17	2	CBT INTEL CO
769	30-118	1	CBT INTEL CO (CI)
790	30-14	1	CBT INTEL CO (SEP BDE)
779	30-14	1	CBT INTEL CO (ACR)

TABLE 6-1 (CONT)

EAD MARTS CANDIDATE UNITS

COMSR TUN	TOE	EA	UNIT
MILITARY POLICE:			
607	19-272	1	MP GP
629	19-76	2	MP BN
630	19-77	8	MP CO
610	19-500	2	MP BN
600	19-047	1	MP CO (ESCRT)
604	19-247	1	MP CO (GRD)
621	19-500	1	MP DET (CORPS)
609	19-500	6	MP DET (CI)
ORDNANCE:			
355	9-520	7	EOD DET
REAR AREA OPNS CEN:			
884	54-422	4	AREA SPT GP (RAOC)
TRANSPORTATION:			
898	55-12	1	TRANS GP
955	55-7	1	TRANS MVMT CONT CTR
958	55-19	1	TRANS CO (CAR)
956	55-16	2	TRANS BN (MT)
959	55-67	6	TRANS CO (LT/MED)
904	55-17	4	TRANS CO (LT)
957	55-18	6	TRANS CO (MED)
908	55-28	2	TRANS CO (HVY)
SIGNAL UNITS:			
	11-122	1	HHD, SIG GP CORPS
	11-86	4	HHC, AREA SIG BN
	11-87	11	AREA SIG CO
	11-102	1	HQ CORPS SIG BDE
	11-96	1	HHC, CMD OPNS BN
	11-77	1	CMD RADIO CO
	11-97	1	TP OPNS CO
	11-98	1	COMM CENTER CO
	11-( )	1	CMD SUPPORT CO
	11-127	1	SIG MDM HQ CO

Equipping units in the Corps and Theater Army with SU1's and SU2's creates requirements for range extension and access to the area systems that cover the Corps and Theater Army areas of responsibility. Should the units identified in this listing be equipped with SU1's and SU2's, the Corps and Theater Army areas would require range extension and access to the area system. There are certain approaches that provide some, but not all, of these requirements; the methods that appear most suitable are described as follows:

- Provide a facility at each node capable of providing the range extension between two or more subscribers within range of the node and access to the area system. The multichannel trunking system access would allow any subscriber within range of the node to talk to or communicate with any subscriber served by the area or command systems. Sites for area nodes are selected to achieve LOS with three or four distant sites; in some cases, this would provide ideal coverage. However; in others, it may be completely unsuitable because distance between area nodes is such that there would be large areas where access would be impossible because of masking by intervening terrain or being beyond the maximum range of MARTS equipment.
- Alternatively, provide a radio central that would provide range extension and access to the area system through an extension multichannel link, as illustrated in figure 6-1. These Radio Centrals would be located as needed to provide area coverage without use of the multichannel module which would be required if the multichannel system did not exist.

Within Concept ECHO, DA TDMA single and multichannel TACSAT terminals could be employed at all echelons. The recommended use of these equipments in EAD is for substitution of TACSAT FDMA equipments of earlier concepts and, at a minimum, the following identified applications.

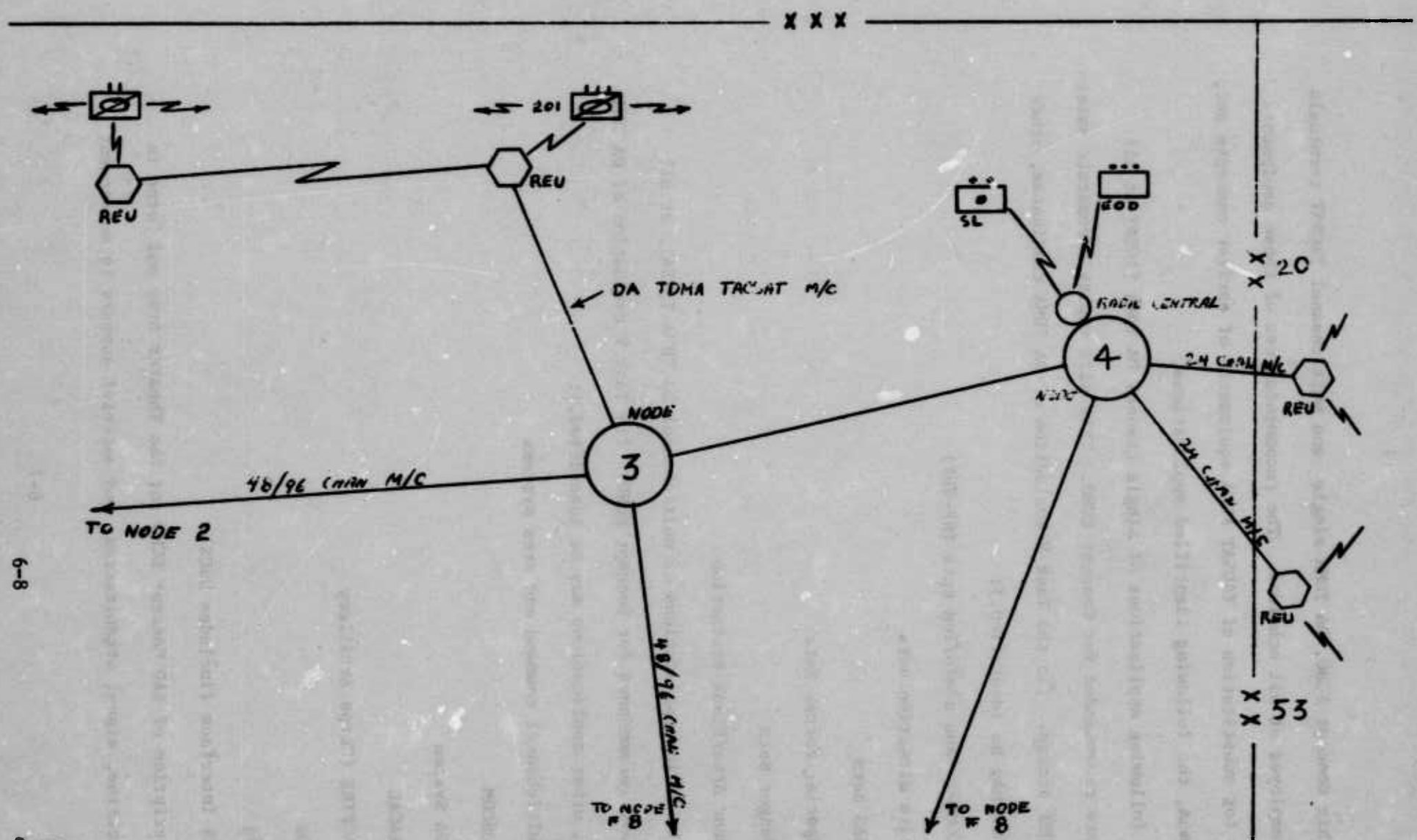
The following applications of single channel DA TDMA TACSAT at all echelons are recommended for Concept ECHO. This will employ a separate satellite for UHF access. (In the Task V evaluation of DA TDMA candidates, other applications may be identified.):

- Command and admin/log nets (HF-VHF)
- Fire direction nets
- SAS nets
- Special Forces Nets
- Ranger Nets
- Rear Area/Flank Protection

The following applications of multichannel DA TDMA TACSAT, at all echelons, are recommended for Concept ECHO. (In Task V evaluation of DA TDMA candidates, other applications may be identified.):

- Multichannel command and area systems
- COSCOM
- ADA System
- ASACAC
- TACFIRE (Corps Artillery
- TOS
- CS_3
- DCS Interface (includes DSCS).

A description of EAD Concept ECHO for the Theater Army and Corps in terms of doctrine, signal organization, and materiel appears in subsequent paragraphs.



NOTE:
UPPER PORTION OF FIGURE 5-4

FIGURE 6-1 MARTS WITH RADIO CENTRAL IN CORPS

6.1 CONCEPT FOR THEATER ARMY

6.1.1 Communications System Description

In Concept ECHO, the Theater Communications Command (TCC) is established under the operational control of the unified commander. The TCC will install, operate, and maintain an area communications system in the COMMZ to satisfy the needs of all component commands in the COMMZ. The area system will be extended to specifically designated base complex and force headquarters that require access to the COMMZ area system. This area system is assumed to be configured along the lines of the Theater Army area system described in Concept ALPHA. The exact configuration is to be directed by the theater commander. The TCC will provide command control communications systems for the unified commander both within the theater (to include internal on-base communications for theater headquarters) and to DCS entry stations for out-of-theater needs. Each service will provide its own command control communications system, internal on-base communications for its base complexes, and communications support (on-base) to all service tenants on jointly occupied bases where it is responsible for operation of the base complex.

The Theater Army Signal Brigade will install, maintain, operate, and control the command communications system for the Theater Army. The Theater Army command system will provide direct links from Theater Army headquarters to each Corps Main headquarters and other major subordinate commands, and to each COSCOM plus certain subordinate elements of the TASCOM as required. This system is portrayed in figure 6-2 and reflects the capabilities of DA TDMA.

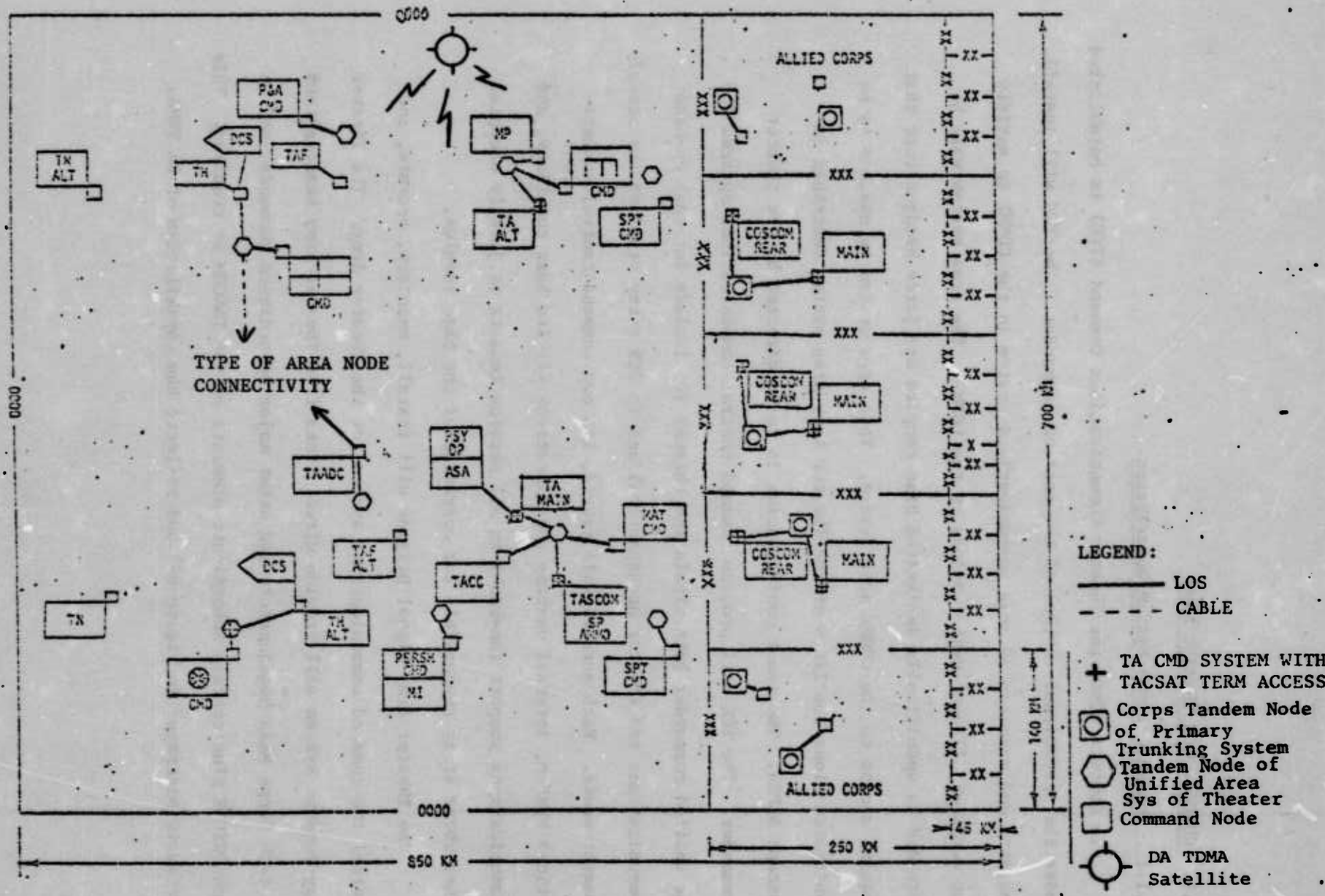


FIGURE 6-2 Concept ECHO Theater Army Command (Direct) System

6.1.2 Communications Functions and Equipments

The communications functions and equipments to support this concept are the same as for Concept CHARLIE, with changes thereto as discussed in the paragraphs that follow:

- Transmission Facilities

  This concept reflects the addition of Tactical Digital Tropo AN/TRC-(DT), limited MARTS and Demand Assigned Time Division Multiple Access (DA TDMA) TACSAT terminals to conventional LOS equipment as used in Concept CHARLIE. The FDMA TSC-85 equipment will be eliminated in favor of DA TDMA TACSAT with due consideration to the limitations of the space segment. The area system provided by the TCC will utilize assets of all the services and the DCS. This composite multichannel trunking and switching system will provide area communications to services in the theater of operations and mobile, transportable communications to support the unified commander. This area system is assumed to be configured along the lines of the Theater Army area system described in Concept ALPHA. The exact configuration is to be directed by the theater commander. TRITAC developed equipment will be employed to the maximum extent possible. The Theater Army command system will employ primarily DA TDMA TACSAT with backup provided through the terrestial LOS/Tropo system of the theater. The command system is further backed up with single channel UHF TACSAT as shown in figure 6-3. The dedicated multichannel system of the ADA utilizes DA TDMA TACSAT down to battalion level and LOS from battalion to battery. This system is backed up through the terrestrial communications systems.

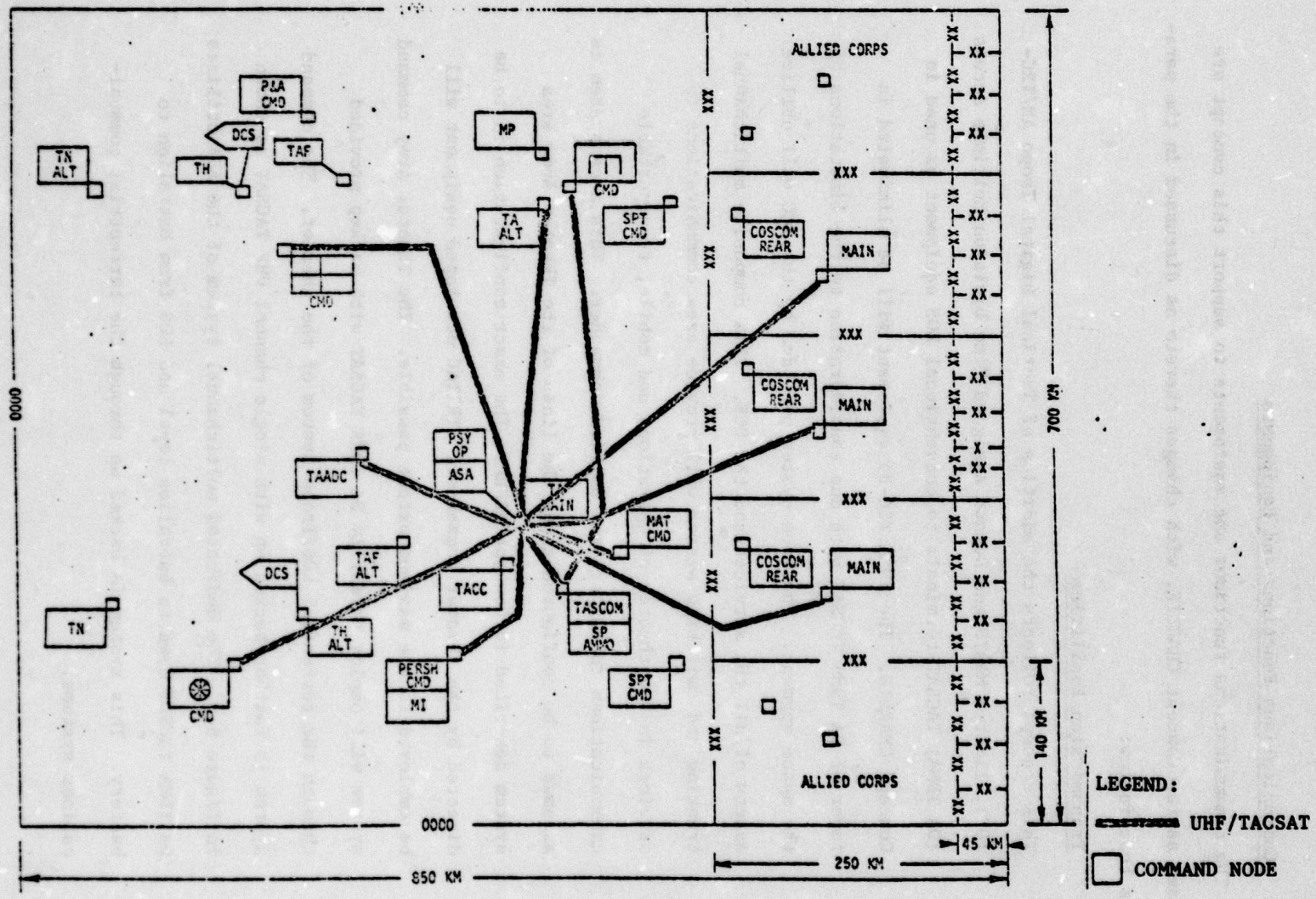


FIGURE 6-3 Concept ECHO, Theater Army Single Channel TACSAT
(Backup for Multichannel)

° Switching

The switching concept employs both voice and message switching. The switching network will be hierarchical, and will consist of local and tandem switching centers. The COMMZ (unified system) switching will be fully automatic for all types of traffic, and will be capable of 100 percent security with interface to respective DCS systems. The Theater Army will employ automatic switching at all echelons down to battalion level. Store-and-forward facilities will be provided. The TRITAC AN/TTC-39 and ULS are utilized with continued use of the current programmed assets of the TTC-38.

° TCCF

Tech control facilities as visualized in Concept CHARLIE Corps sector are expected to be employed.

° Single channel access

Introduction of DA TDMA improved single channel TACSAT and automated RWI capability for VHF/FM and MARTS/SINCTRAC equipments.

° Single channel transmission

Concept CHARLIE VHF/UHF ATC and PRC-68 assets plus introduction of improved single channel TACSAT and selected MARTS/SINCTRAC equipments:

DA TACSAT equipments

UHF Base Station

UHF 1/4-ton

UHF Manpack

UHF RATT Terminal

MARTS/SINCTRAC equipments

MARTS/SINCTRAC Radio Set, Automatic

MARTS/SINCTRAC Radio Set, Semiautomatic

MARTS/SINCTRAC Radio Set, Manual

° Telecommunications Centers

Facilities to be provided are identical to those of Concept CHARLIE Corps sector plus QCS-(M) and Digital Message Device (DMD).

° Wire and Cable Systems

Substantially the same as Concept CHARLIE except where MARTS will be introduced (e.g. Armored Cavalry Regiment and Pershing Brigade are candidates).

° Command Post Communications

No new capability over Concept CHARLIE is expected to be introduced at this level.

° COMSEC

Same as Concept CHARLIE Corps sector

° Terminal Equipments

Equipment options planned to be employed are:

- I/O devices, TTY, and facsimile equipment of Concept CHARLIE plus QCS-(M) and Digital Message Device (DMD).
- DA TDMA TACSAT (S, M, L)
- Tactical Digital Tropo
- MARTS
- DSVT and DNVT

6.1.3 Communications Doctrine

DA TDMA TACSATCOM, certain MARTS applications, and other TRITAC equipments are the principal hardware changes in the Theater Army under Concept ECHO. Of equal importance, however, is the change of management responsibility to reflect the Army's operation and maintenance of the unified command's multichannel trunking and switch-area system serving the needs of all services and the theater commander in the COMMZ. In this case, the TA signal organization provides the TA command multichannel communications system and the theater (unified) area communications system, the latter of which replaces the TA area system depicted under Concept ALPHA.

- Several doctrinal publications will require revision to reflect Concept ECHO for Theater Army communications under EAD to include FM 11-23, Theater Army Communications Command, and numerous others.

6.1.4 Signal Organization

- To support both Army and joint communications requirements in Concept ECHO, an element of the USA Communications Command is established in the theater under Concept ECHO as the senior Army communications command serving the needs of both the theater and theater Army commanders. Under USACC, the TA Signal Brigade is responsible for the TA command system employing DA TDMA TACSAT and the COMMZ Area Signal Brigade is responsible for the theater area system serving all users in the COMMZ. The area system also provides access facilities for the TA units equipped with MARTS subscriber units. Of note is the TA Signal Brigade not being required in Concept ECHO to furnish distant terminals at the Corps because of the employment of demand assignment TDMA TACSAT in the TA command system.

Recommendations will be made regarding TOE personnel and equipment changes in supporting signal organizations resulting from the ECHO employment of:

- DA TDMA TACSAT in TA and ADA systems
- MARTS EAD application in certain TA units
- Automatic switching TTC-39 (hybrid) with S/F
- Automated TCCF (CSPE, CSCE, CNCE)
- Tactical Digital Tropo
- End-to-end COMSEC

6.2 CONCEPT ECHO FOR CORPS

6.2.1 Communication System Description

In Concept ECHO, the Corps is provided an area-type primary trunking system with tandem switching. The command communications links (direct) are provided by patching trunk groups from Corps Main to subordinate Divisions, COSCOM and other major subordinate headquarters. This primary trunking and switching system also provides area communication service to units throughout the Corps Area. This system interconnects with the unified area system at the Corps rear boundary and the Division's systems at Division Main and DISCOM nodes. MARTS is deployed in the area system and in selected units as discussed in Concept ECHO for Theater Army. The primary trunking and switching system proposed for Concept ECHO is presented in figure 6-4. The same DA TDMA TACSAT that provides Theater Army command circuits also provides minimum direct command circuits from Corps Main, COSCOM, subordinate Divisions, and the Separate Brigade as backup to the primary system. This same system provides circuits from the Corps Artillery to its Groups and from the ADA Group to its battalions. This backup direct system is presented in figure 6-5.

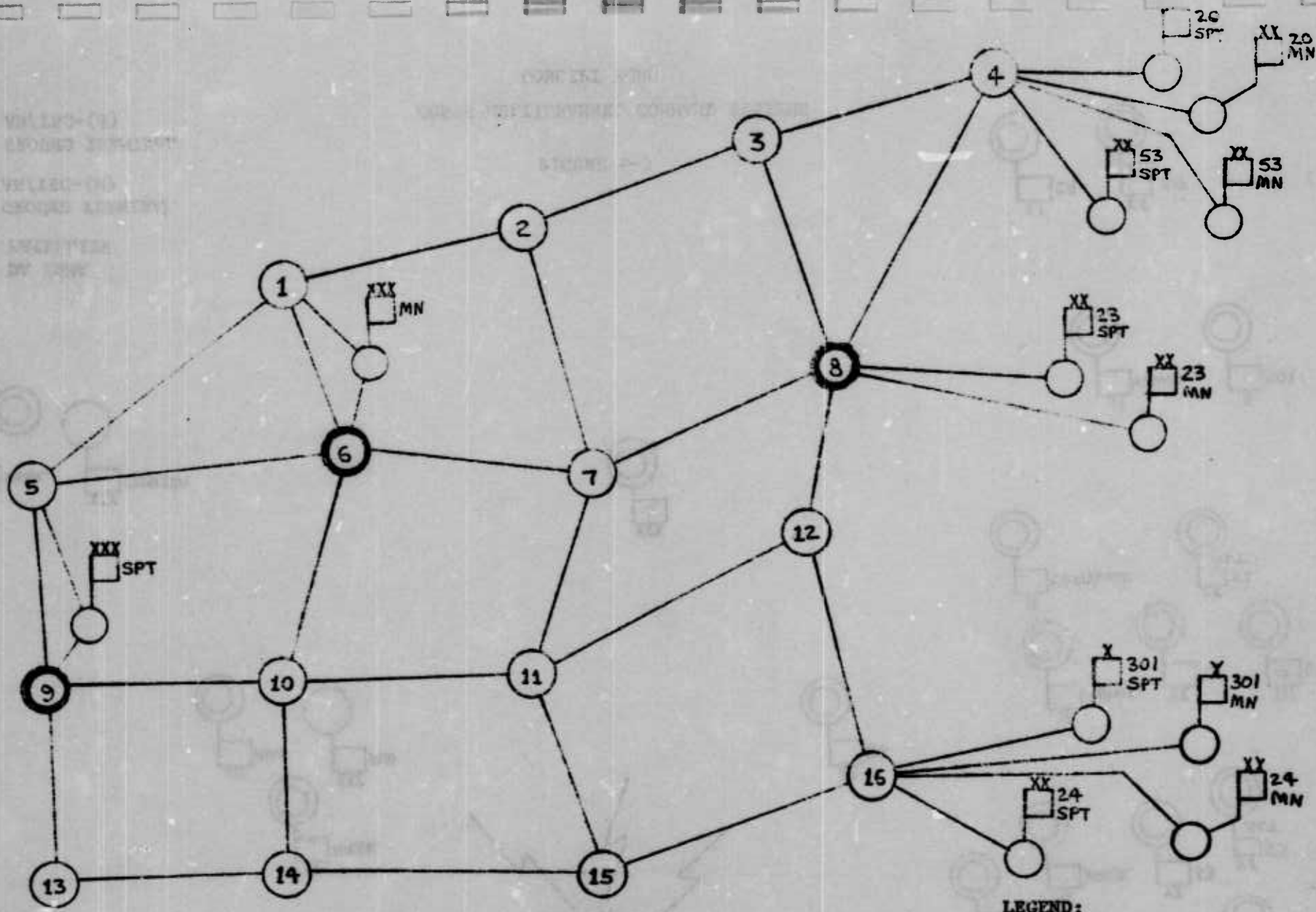


FIGURE 6-4

CORPS AREA MULTICHANNEL SYSTEM

CONCEPT ECHO

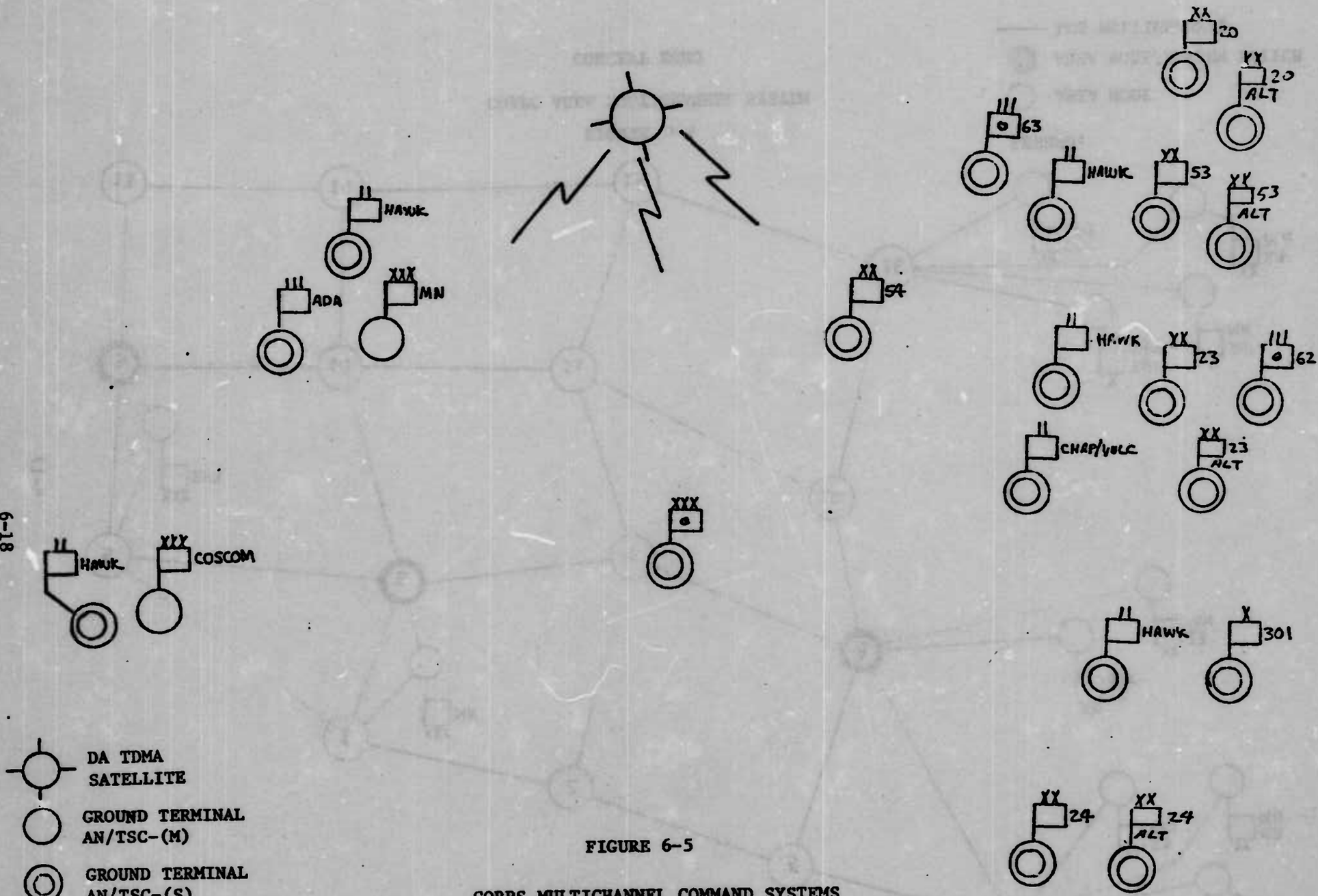


FIGURE 6-5

CORPS MULTICHANNEL COMMAND SYSTEMS

CONCEPT ECHO

6.2.2 Communications Functions and Equipment

- Multichannel transmission

  The LOS multichannel assets are the same as in Concept CHARLIE. DA TDMA TACSAT is introduced to provide minimum circuits in the command systems. MARTS deployment is as described in Concept ECHO for Theater Army.

- Switching

  Automatic switching is provided at area nodes providing tandem switching. Automatic switching is provided at Corps and its major subordinate units, with the 15-line ULS employed in addition to 30-150 line ULS. Store and forward message modules are at selected area nodes and at Corps Main.

- TCCF

  Same as Concept CHARLIE

- Single Channel Access

  Introduction of DA TDMA UHF TACSAT and automated RWI (option 10) capability for VHF/FM and MARTS/SINCTRAC equipment.

- Single Channel Transmission

  VHF/UHF ATC and PRC-68 same as Concept CHARLIE

  MARTS Subscriber Unit with ECCM

  MARTS/SINCTRAC Radio Set, Automatic

  MARTS/SINCTRAC Radio Set, Semiautomatic

  MARTS/SINCTRAC Radio Set, Manual

  DA TACSAT UHF Terminal, Manpack

  DA TACSAT UHF Terminal, 1/4-ton

  DA TACSAT UHF Terminal, 1 1/4-ton

  DA TACSAT UHF Receiver/Transmitter

- Telecommunications centers

  Concept CHARLIE assets plus QCS-(M) and Digital Message Device (DMD)

- Wire and cable

  Concept CHARLIE assets

- Command Post Communications

  Concept CHARLIE assets except MARTS will satisfy the requirement in selected units

- COMSEC

  Concept CHARLIE assets, MARTS optimized for TENLEY

- Terminal equipment

  I/O devices, TTY, and facsimile equipment of Concept CHARLIE plus QCS-(M) and Digital Message Device (DMD).

6.2.3 Communications Doctrine

Concept ECHO for the Corps employs DA TDMA TACSATCOM in the command system and LOS multichannel equipment in the area system. The employment of automatic-circuit and message switching, automated TCCF equipments, improved means of telecommunications processing, together with application of MARTS to certain EAD units within the Corps, will require that a complete new set of communications doctrinal literature be generated for the EAD Corps. The current FM 11-92, Corps Signal Communications, will have to be rewritten, not only to reflect the employment of Concept ECHO resources, but also to show the Corps communications doctrine under EAD. Under the EAD concept, FM 11-125, Field Army Signal Communications, now obsolete, must also be addressed. In Concept ECHO, a significant doctrinal change is the stipulation that the Corps Area system is primary and the command system is installed as backup.

6.2.4 Signal Organization

The communications support organization for the Corps will require substantial revision to accommodate the resources employed under Concept ECHO, particularly as regards the support for the Corps command system and the various nodes to provide access for those units equipped with MARTS subscriber units. The Corps signal organization will not be required to provide distant command system terminals at the major maneuver units, as in previous candidate concepts, due to the demand assignment capability of the ECHO TDMA TACSAT.

APPENDIX A

DEMAND ASSIGNED TDMA TACSATCOM

TECHNOLOGY BASE

1.0 TACSATCOM TECHNIQUES

Both single-channel and multichannel DA TDMA TACSATCOM are being developed under TRITAC. It is recognized that the Army is the proponent service for multichannel and that the Navy is the proponent service for single channel with Army participating.

During the INTACS mid-range time frame, upgraded single-channel (UHF) and multichannel (SHF) TACSAT transmission facilities are planned to be introduced into the inventory. Within INTACS Task V, these equipments will be considered in difficult communications terrain and long haul multichannel applications, and in cases where the range and/or the terrain dictate the need for single-channel, terrain/range-insensitive communications with units or forces at extended distances and/or in difficult terrain. Among the advantages offered by TACSATCOM are quick setup/teardown times, flexibility, and mobility. The key factor of TACSATCOM, compared to the conventional systems, is that it is range-insensitive. It is effective over long distances (thousands of miles) as well as over relatively short distances, if the terrain or situation warrants its use.

One major area to be considered in evaluating the system is susceptibility to uplink jamming. Recent studies, in which TACSATCOM has been compared to conventional approaches (HF, TROPO, LOS) for both multichannel and single-channel applications, have produced overall performance characterization ratings of marginal-to-unsatisfactory for the conventional approach, and good for TACSATCOM.

Introduction of DA TDMA to TACSATCOM will increase the limited capacity of the satellite with its current utilization of preassigned FDMA. Any shortfalls in channel capacity with the FDMA approach, resulting from the inability of TACSATCOM to provide enough service as defined in Concepts BRAVO and CHARLIE, can be accommodated with the DA TDMA technique in Concept ECHO. A change from preassigned FDMA to DA TDMA technique will expand the capacity by approximately four times, i.e., it is expected to provide a four-times increase in users capacity for the same bandwidth. Advantages and disadvantages of FDMA and TDMA systems are given in tables A-1 and A-2; respectively.

TDMA techniques have been found to provide a number of overall system advantages when a group of ground terminal complexes use a common central relay to establish connectivity among them. In a TDMA system in which the terminal complexes access the relay sequentially, many of the problems inherent in multiple access techniques based on simultaneous relay utilization by the terminal station complexes are no longer present. TDMA techniques tend to easily accommodate participating terminal stations with a wide range of traffic requirement. Effective use of the relay's repeater power is achieved in TDMA, since there is no requirement to operate within the linear range of the power amplifier to minimize the effects of intermodulation.

TDMA is the process whereby a communications channel is divided into a number of discrete time slots. The shortest practical time slot, limited by current state-of-the-art logic, is 30 nanoseconds (30×10^{-9} second). Each terminal in the system will be assigned a time slot of this duration on a given channel, and will transmit in a burst mode each time. This will greatly increase the number of subscribers each channel can accommodate without loss in communications capability per terminal. Uninterrupted voice communications can be expected in this mode, just as with a straight-through channel. This is possible because the time slots are so small and so frequent that no loss of communications in a conversation can be perceived.

TABLE A-1

Advantages/Disadvantages of FDMA

Advantages	Disadvantages
• Channel assignment by frequency division allows relatively simple selection of transmitter and receiver frequencies to select channel accesses. • No stringent terminal timing is required. • The technique of modulation and frequency selection is compatible with existing techniques and equipment availability. • Repeater access control is determined by relatively simple procedures once a frequency plan has been devised.	• Simultaneous signals at the repeater produce intermodulation products. • Repeater must be operated below saturation to minimize the effect of signal interaction (represents a 3.0 dB loss in available repeater ERP). • Uplink power coordination is required. • It cannot easily accommodate a large number and flexible mix of access channels or channel groups.

TABLE A-2

Advantages/Disadvantages of TDMA

Advantages	Disadvantages
• Avoids problem of mutual interference among signals in repeater.	• Requires accurate network timing, ranging, and framing (added complexity).
• Allows a considerable degree of flexibility in the communications system to accommodate a mix of user stations with different receiver capabilities.	• Development for tactical applications is not as advanced as for FDMA.
• Can handle uplink power disparities among user stations and requires no uplink power coordination.	
• Can have the highest information rate for a given satellite power output.	
• User station can use high peak, low average power amplifiers, reducing size and prime power requirements.	
• Four times the channel capacity of FDMA, with the same frequency stabilization.	
• Reduces the number of up/down converters.	
• Produces reduced life-cycle costs.	

Demand-assigned TDMA is the same as described above, except that no fixed assignment of time slots is made. Upon initiation of communications, a scanner-type device will search the channels and locate an unused time slot for the calling and the called station. Such channel surveillance will permit increased usage of the bandwidth over that above, since each time slot is available to any station on a demand basis and, therefore, is being used more efficiently and effectively.

A technical assessment of TDMA is given in the following paragraphs:

- The present family of tactical satellite communications terminals under development (AN/TSC-85 and AN/MSC-59) are designed to operate through a common satellite repeater on a preassigned FDMA basis. FDMA, although easier to implement, has the following deficiencies:
  - Less efficiency than TDMA
  - Requirement for power control.
- TDMA has the advantage of higher efficiency, greater flexibility (one terminal could essentially communicate with all other terminals), and essentially no power control. One of the disadvantages is that it does require a high timing accuracy.
- The techniques for TDMA have been developed and successfully
- development model has been developed by the Army for the Defense Satellite Communications System (DSCS). This equipment is planned for delivery in 1974 and will undergo system tests over the DSCS Phase II satellite.
- The development of demand-assigned techniques is also well-known. The INTELSAT System employs a demand-assigned FDMA system called SPADE.

Fifteen countries are presently using this equipment very successfully. Based on the present technology, it is considered that essentially no major technological breakthroughs are required to develop DA TDMA, although there are risk areas. The overall effort is considered to involve a moderate risk. The recommended approach to provide equipment with the essential characteristics will require both advanced and engineering development efforts. The areas of concern are as follows:

- Size, power, and weight - The DA TDMA will essentially replace the pre-assigned (PA) FDMA equipment currently in the AN/TSC-85 and AN/MSC-59. These terminals have been designed to a stringent size, power, and weight budget. It is desirable that the DA TDMA does not exceed these budgets.
- System control and integration with TRI-TAC equipments - Interface with TRI-TAC will be required at various levels (e.g., with the Multi-Level and Unit Level Switch.) Careful consideration will be required to design the DA TDMA to meet stringent requirements imposed by these switches.
- Communications security (COMSEC) - The TRITAC system will employ both end-to-end encryption and bulk encryption. Investigations will be required to determine the best means of operating within these constraints.
- Timing and ranging - In order to achieve an efficient DA TDMA system, all earth terminals will require precise timing. Although the development techniques are well-known for the timing and ranging units, the feasibility of providing these equipments in the size, weight, and power requirements will involve some risk.

1.1 SINGLE CHANNEL

The DA UHF TDMA modem are planned for use as part of the Army UHF TACSATCOM terminals. These terminals will replace existing HF equipment in those instances where circuit reliability and responsiveness are of paramount importance but presently not available. The terminals will provide commanders with secure, low-rate digital, continuous, critical command and control communications using a digital message entry device (DMED). Additionally, 16 kbps secure voice via satellite channels may be used under emergency or highest priority conditions for ordnance delivery and command and control communications. Existing HF equipment presently used for less critical communications will be retained and improved, where possible.

Sufficient UHF satellite traffic capacity is presently not available to meet all identified priority demands for the capability. This insufficiency will become even more critical as the satellites begin to age and the capacities of individual satellites begin to gradually decline. The DA UHF TDMA modem is required to maximize the traffic capacity of current and programmed UHF satellites. The requirement is urgent, due to the high critical priorities of the traffic supported. The modem will provide the following:

- Burst rates consistent with the performance parameters of planned terminals
- Demand assignment of TDMA network subchannels, such that the time duration beginning with the demand for a channel and ending with a channel being made available shall not exceed three seconds, provided a vacant channel exists
- Capability for preempting lower precedence traffic in the TDMA network timing

- TDMA network control capability. If a special control facility is required, backup capability should be available to permit continuous network operation without catastrophic network failure in the event of loss of the primary control facility.
- COMSEC capability of all information and signaling traffic using standard COMSEC devices
- Antijam capabilities
- User data rates of 75, 300, 600, 1200, 7400, 8000, 9600, and 16,000 bps (32,000 bps desired) consistent with channel capabilities
- Selectable common users and broadcast capability
- Maximum protection from radio direction finding (RDF) threats by minimizing transmission times for short messages.

1.2 MULTICHANNEL

The need exists for a multiple access system for SHF tactical satellite communications to provide maximum traffic capacity, system flexibility, and responsiveness in order to adequately support the DoD tactical COMSR's. The DA TDMA technology promises to have the cost-effective tactical communications capability to fulfill this need.

Present and planned SHF TACSATCOM systems will not provide the total traffic capacity required to satisfy critical needs: these systems utilize preassigned trunks. Although changing requirements for channels can be met by reconfiguring links, excessive time is required. The demand-assigned multiple access system will establish and break these connections on a call-by-call basis. This should result in a fourfold increase in effective system capacity, by allowing the total system to be shared automatically by all terminals.

The SHF demand-assigned multiple access system will employ TDMA techniques, and are planned to have the following characteristics:

- Provide both preassignment and demand-assignment of channels
- Permit communications security of both information and signaling traffic, using appropriate COMSEC devices
- Provide traffic flow security
- Support user data rates of 16/32 kbps with link group sizes of 4-1/2, 9, and 18 channels
- Provide burst rates consistent with the performance parameters of planned SHF TACSATCOM terminals
- Be balanced-hardened against both nuclear and non-nuclear threats
- Provide for the preemption of lower precedence traffic in the demand-assigned multiple access network
- Have the capability to preclude a terminal from transmitting if it has lost (and is unable to acquire) proper network timing
- Incorporate a failsafe system control compatible with the overall TRI-TAC system control concept
- Be capable of operation and storage in accordance with the applicable MIL STD specification
- Be compatible with and make maximum use of existing and planned TACSATCOM and TRI-TAC equipments
- Reliability, availability, and maintainability (RAM) to be provided by the U.S. Army Satellite Communications Agency (USASATCOMA).

1.3 TACSAT ALTERNATIVES

At this stage in the development of the DA TDMA TACSAT, there are a number of alternatives facing the multichannel and single channel systems designers. The major multichannel system design alternatives are:

- Retrofit versus new ground terminals
- Centralized versus distributed control of the pre-assignment and demand-assignment traffic loads
- Separate versus integrated handling of pre- and demand-assigned traffic. Separate equipments to meet individual services requirements versus modular implementation
- In-band versus common channel signalling.

These are some of the alternatives that COMSAT is currently studying under contract from Satellite Communications Agency (SATCOMA). Partitioning of designs based on cost effective criteria will select the method from among the above and other possible choices. Task V will report on findings known at that time from the study concurrently being done by COMSAT.

The major alternatives for single channel design are:

- Conventional equipment versus TACSATCOM terminals
- Introduction of a multiple access system with automatic signaling
- Size/Weight/Cost of TACSATCOM equipments as a function of the TDMA modem and control complexity
- Provision of positive net control features to avoid loss caused by simultaneous transmission on half-duplex nets

These are some of the major design alternatives and considerations in defining a DA TDMA system for TACSATCOM, UHF single channel links.

2.0 BACKGROUND INFORMATION

This section of Appendix A presents a technology base that pertains to both SHF multichannel and UHF single channel tactical satellite communications, based on projected implementation using DA TDMA. It should be recognized that the DA TDMA technology is in an advanced systems study phase; both SHF and UHF activities have just been initiated at the systems analysis stage. Therefore, hard descriptions of precise equipments do not exist, and the approach presented herein has been to address the technological and operational performance needs and envisioned goals as stated in various draft GFI documents. It is believed that, in the subsequent Task V reports on Candidate design of ECHO, more definite data will be available than this appendix presents.

The GFI documents and the notes from meeting listed below were used as the basis for defining and refining the single channel (UHF) and the multichannel (SHF) DA TDMA tactical satellite communications concept portion of the INTACS MRTF Concept ECHO:

1. Department of the Army, Headquarters, U.S. Army Communications Agency, Fort Monmouth, New Jersey. "Study on Tactical TDMA Considerations".
2. MEMO, Subject:
   "Study of Functional Requirements for Demand Assigned SHF TDMA Modems".
3. Statement of Work

Multi-Mode Transmission Multiple Access and Modulation Concept Study.

4. Minutes of TACSATCOM TDMA meeting, 1 May 1974.
5. Network Requirements for Demand Assigned UHF TDMA Satellite Modem (Draft).
6. Strawman JOR for SHF DAMA System.
7. Proposed Comments on Strawman JOR for DA UHF TDMA Modem.
8. Enclosure # 1 to SER 941 N - 3208 UHF TDMA - NAVY.
9. UHF TDMA Modem Joint Operational Requirements.
10. Notes of Telecon with Jim Noony - Navy.
11. Notes on Briefing on the Army (Tactical Satellite Communications 28 March 1974).
12. Minutes of SATCOMA Meeting (with INTACS personnel) (17 May 1974).
13. U.S. Army TACSATCOM Program Study.

2.1 TRI-TAC RESOURCES

The tactical satellites under consideration for deployment in INTACS Concept ECHO will be developed under the TRI-TAC program. Integration of these resources into ATACS are treated in transition plans.

2.2 PROJECTED TRI-TAC MULTICHANNEL AND SINGLE-CHANNEL DA TDMA RESOURCES

This section briefly introduces the projected TRI-TAC DA TDMA future TACSAT resources for multichannel and single-channel use.

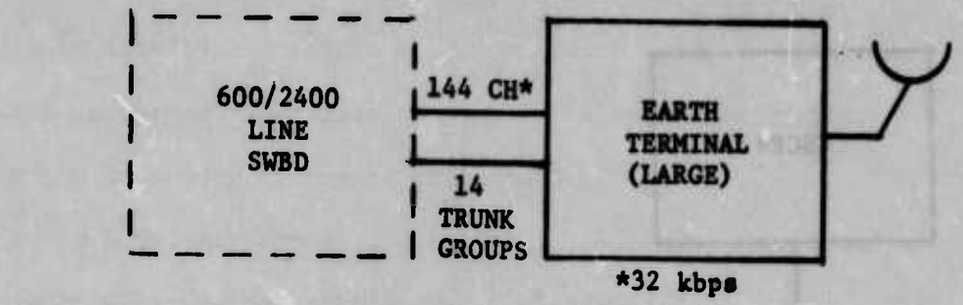
2.2.1 Multichannel Resources

Three sizes of earth terminals have been identified, as shown in figure A-1. The small terminal at Brigade level will interface with the unit level switchboard through a single trunk group, and will be capable of handling 4-1/2, 9, or 18 channels maximum (32 kbps). An intermediate terminal will be used at Division and Corps levels. This terminal will interface with 150/300-line switchboards through 10 trunk groups, and will be capable of handling 36 channels maximum (32 kbps). A large terminal will be used at Theater Army level. This terminal will interface with a 600/2400-line switchboard through 14 trunk groups, handling up to 144 channels (32 kbps).

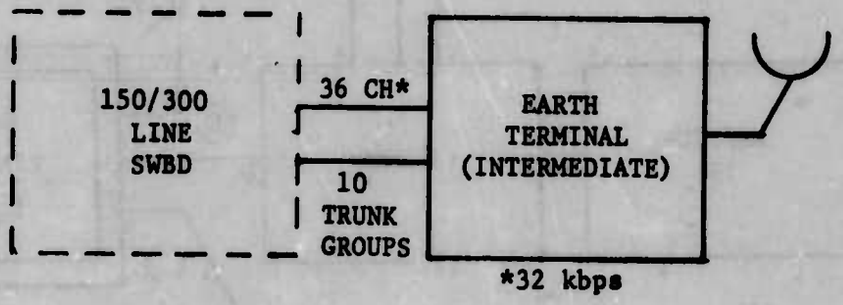
Figure A-2 identifies terminal/switch interfaces. Trunk-grouped channels will interface from the earth terminals to the new switchboards (Unit Level and AN/TTC-39) by way of the TCCF communications equipment support element (CESE). Management control interfaces will be made between the earth terminals and the TCCF CESE's and communications nodal control elements (CNCE). In the succeeding Task V reports, the systems, subsystems, and equipment definitions, conflicts, ramifications, and recommended approaches to solutions will be addressed.

2.2.2 Single-Channel Resources

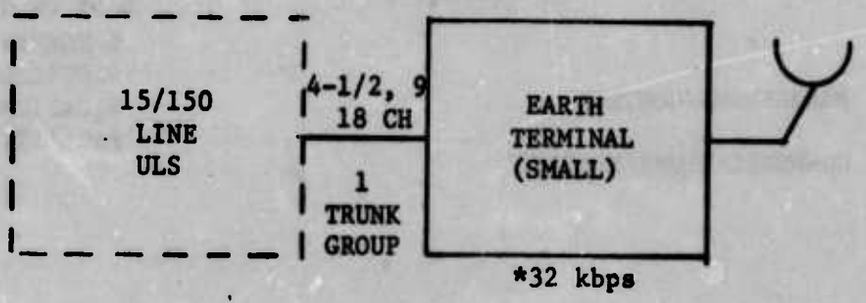
The task force (TF)/task group is the major tactical force of the future Navy. The TF SATCOM system is required to provide the beyond line-of-sight (BLOS) communications connectivity for this task force/task group tactical force. A TF SATCOM coverage sector (depicted in figure A-3) is required to provide the BLOS communications connectivity for up to four such tasks forces and a number of isolated platforms (IP) which may enter the satellite coverage area. A signaling channel is provided to allow multiple access demand-assignment operation of satellite channels which, when coupled with exterior communications systems (ECS) automation techniques, will require a minimum of



LARGE TERMINAL - THEATER-LEVEL, TABS



INTERMEDIATE TERMINAL - DIVISION, CORPS, CRC



SMALL TERMINAL - BRIGADE

FIGURE A-1 TRI-TAC DA TDMA SHF Terminals (Multichannel)

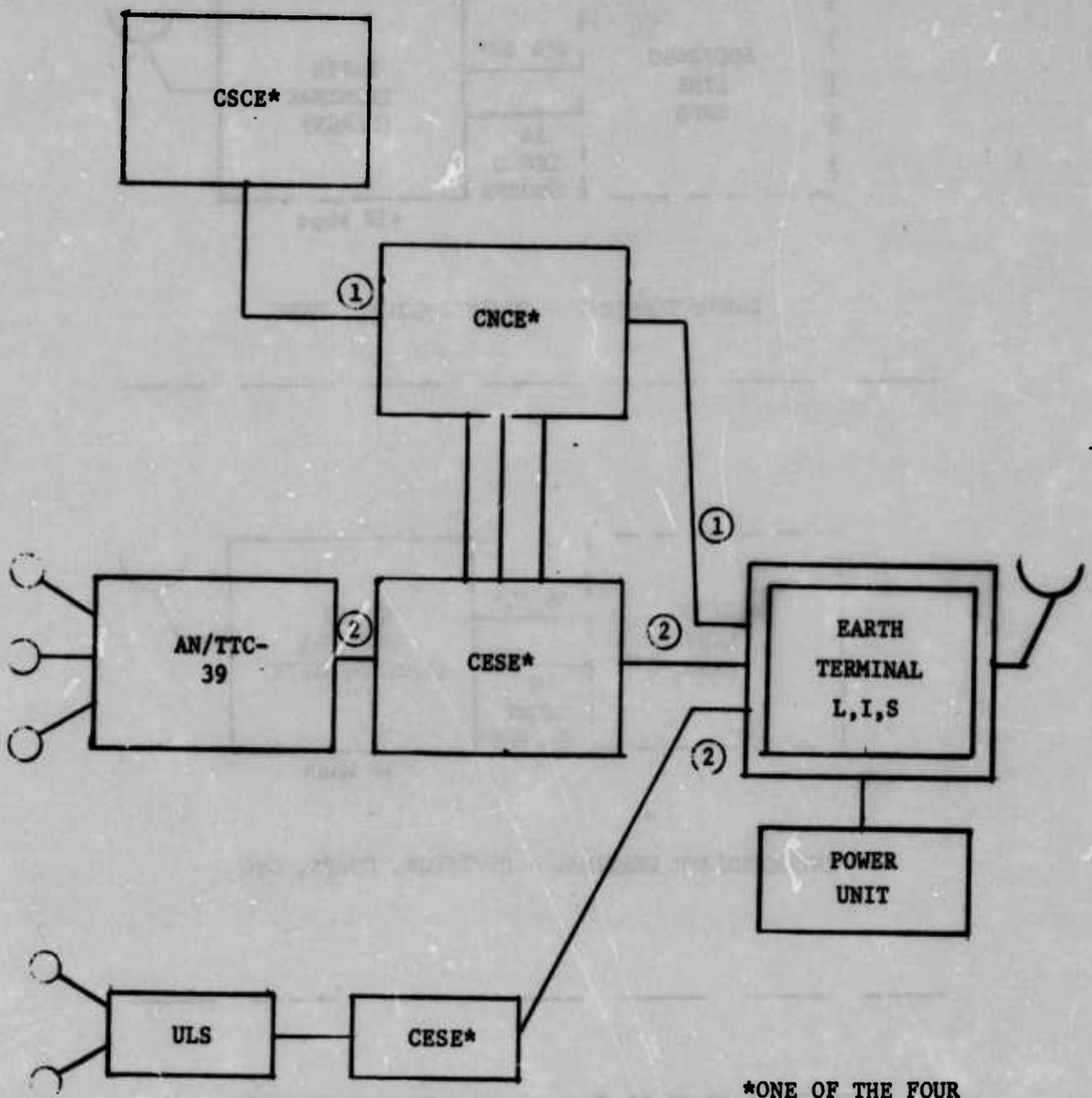


FIGURE A-2 Principal DA TDMA TACSAT Interfaces

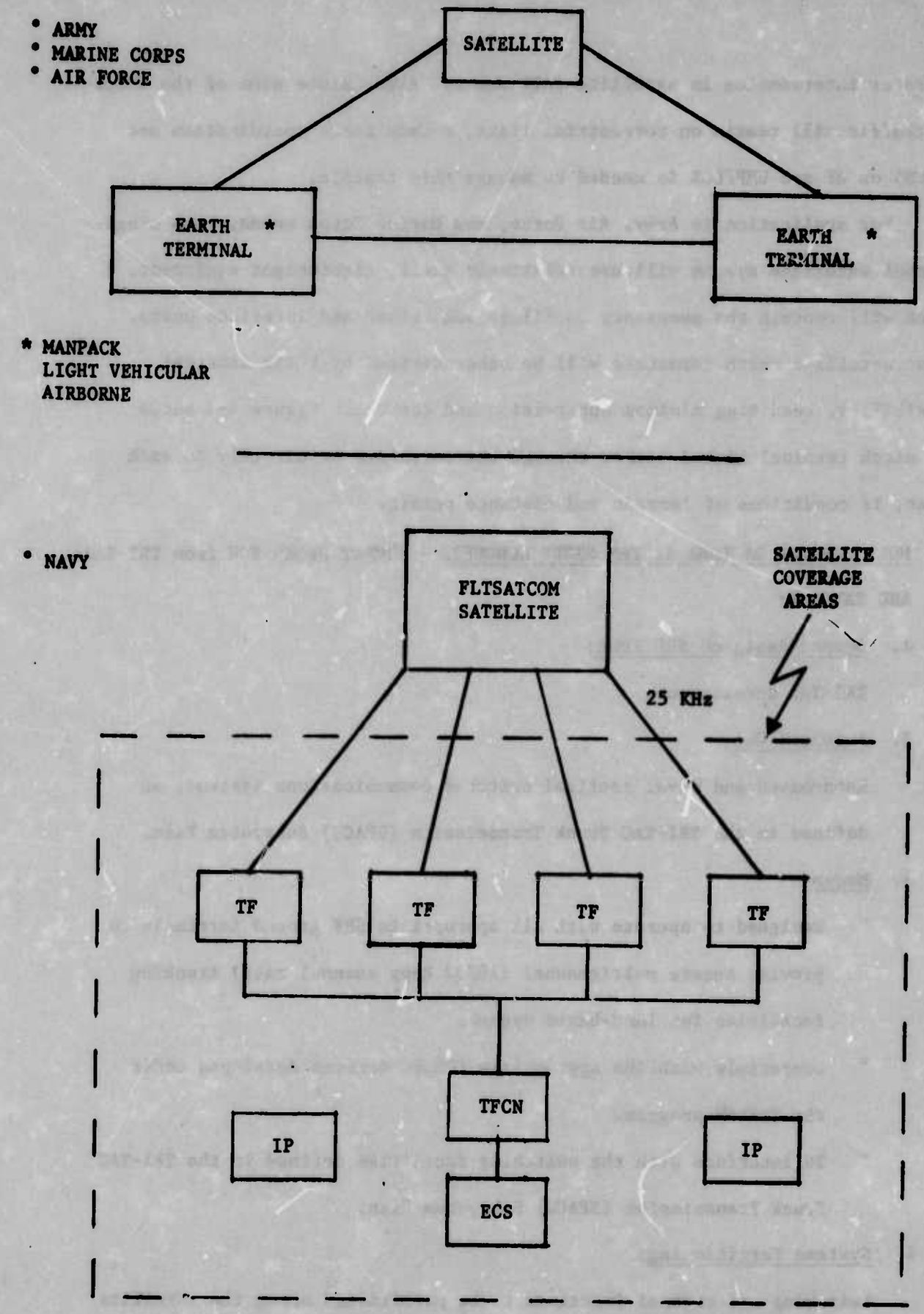


FIGURE A-3 TRI-TAC Single Channel DA TDMA Terminals

operator intervention in satellite call setup. Also, since some of the intra-TF traffic will remain on terrestrial links, a task force coordination net (TFCN) on HF and UHF/LOS is needed to manage this traffic.

For application to Army, Air Force, and Marine Corps needs, this single-channel satellite system will use relatively small, lightweight equipment, which will contain the necessary ancillary subscriber and interface units. These satellite earth terminals will be caharcterized by their inherent flexibility, requiring minimum supervision and control. Figure A-3 shows the earth terminal linked either through the satellite or directly to each other, if conditions of terrain and distance permit.

2.3 MULTICHANNEL DA TDMA SYSTEM STUDY CONCEPTS - COMSAT Study SOW from TRI-TAC AND SATCOMA)

1. Demand-Assigned SHF TDMA:

   TRI-TAC development.

2. Intended Use:

   Land-based and naval tactical switched communications systems, as defined in the TRI-TAC Trunk Transmission (SPACE) Subsystem Plan.

3. Modem:

   - Designed to operate with all appropriate SHF ground terminals to provide secure multichannel (16/32 kbps channel rate) trunking facilities for land-based systems.
   - Compatible with the appropriate COMSEC devices developed under the TENLEY program.
   - To interface with the switching facilities defined in the TRI-TAC Trunk Transmission (SPACE) Subsystem Plan.

4. Systems Partitioning:

   Switching and control functions to be partitioned among the satellite terminals, switching, communications control elements, COMSEC, and

subscriber access systems elements.

5. Mixture of Preassigned and Demand-Assigned Channels:

Traffic needlines and technology must be analyzed for a determination.

6. Nodal Needlines:

- Land-based models based on Army, Air Force, and Marine Corps deployments, per TRI-TAC System Plan.
- Naval models based on TRI-TAC System Plan for Naval Tactical Switched Communications Systems.

7. Common versus Distinct Service:

TDMA system to be investigated.

8. Performance Definition:

Determination to be made for capacities, quantity, and modularity of trunk group sizes, degree of satisfying needlines, grade of service, bit error rate at each echelon of deployment.

9. Satellite Transponder Channel and Link Parameters:

Per Subsystem Plan for Trunk Transmission (SPACE).

10. Earth Terminal Characteristics:

- Small: Lower echelons, interfaces with unit level switch sizes of 15-150 terminations, provides a single trunk group interface of 4-1/2, 9, or 18 channels.
- Intermediate: Used at Division or Corps, in conjunction with 150/300-line automatic switches, provides up to 10 trunk groups of 4-1/2, 9, 18, or 36 channels, maximum combined capacity of 90 channels.
- Large: Used at higher echelons, with 600/2400-line switches, provides up to 14 trunk groups of 144 channels maximum.

11. Terminal/Switch Interface:

- CESE's of the AN/TTC-39
- CNCE's of the TCCF
- CESE's of the subscriber access switches
- Interfaces to accommodate 16/32 kbps digital trunks and trunk groups, as well as accomplish nodal configuration and maintenance of network discipline and management with CNCE/CSCE.

12. Assignment Method:

Determination to be made of employment of TDMA using demand assignment, preassignment, or a combination of the two.

13. TDMA Modem Tradeoff Issues:

- Distribution and mix of demand-assigned and preassigned channels and groups;
- Terminal channel capacity and modularity;
- Separate versus integrated preassigned and demand-assigned terminals;
- Allocation of signaling and control functions among the earth terminal, circuit switch, and family of TCCF elements;
- Implementation of traffic flow and traffic characteristics security;
- Common channel versus in-band signaling techniques;
- Degree of control over terminal connectivity and call routing;
- TRI-TAC COMSEC and system control concepts;
- Ease of retrofit of inventory earth terminals;
- Modem design parameters: modulation technique, burst rate, signal format, timing, acquisition technique, optimum buffer size and configuration;
- System control technique: Must be TRI-TAC compatible, must provide for network control, access control, and orderwire functions, trunk signaling, and monitoring functions.
- Modem control effectiveness when under electronic jamming to assure graceful performance degradation.

14. Implementation Cost Considerations:

- TDMA introduction impact on overall system elements;
- Minimize unit, recurring, and operations costs;
- Degree of achievable commonality of design among land-based and naval systems;
- Existing operational procedures and configurational impacts, utilizations;
- Control system complexity, sophisitication of the modem implementation and placement of COMSEC equipment;
- Modifications to existing equipments to allow TDMA implementation;
- Requirement for peak power amplifier and use of error correction devices.

15. TDMA Specifications:

- Concepts and techniques determined to be most cost-effective in the tradeoff analysis shall be specified.
- Specific areas addressed to be:
  - Characteristics and functional requirements
  - Interfaces with other equipments
  - Terminal modifications
  - Switch additions
  - Signaling technique
  - Control system.

2.4 SINGLE-CHANNEL UHF DA TDMA STUDY CONCEPTS

1. Demand-Assigned UHF TDMA:

TRI-TAC development

2. Intended Use:

- Army to use as part of UHF TACSATCOM terminals replacing HF equipment in critical command and control communications as well as provide critical communications for widely dispersed units.
- Fleet Marine Force to use at the Marine Amphibious Force level, Marine Amphibious Brigade, Marine Amphibious Unit, Marine Division, Marine Wing headquarters, and by reconnaissance units or other forward area users.

- Air Force will have a continuing requirement in support of a number of special purpose and high priority users, both Mobile as well as selected ground users.
- Naval use will be required to satisfy the bulk of the beyond line of sight requirements of mobile platforms, connectivity for the Task Force/Task Group Tactical Force (the major tactical force of the future Navy) based upon a policy of decentralization.

3. Modem Performance:

- Provide secure, low rate digital, continuous, critical circuits utilizing a Digital Message Entry Device (DMED).
- 16 kbps secure voice
- Use TDMA techniques
- Demand assignment of TDMA network subchannels such that the time duration beginning with the demand for a channel and ending with a channel being made available shall not exceed 3 seconds, provided a vacant channel exists.
- Capability for pre-empting lower precedence traffic in the TDMA network.
- Capability to preclude a terminal from transmitting if it has lost and is unable to acquire proper network timing.
- User data rates of 75,300,600,1200,2400,8000,9600, and 16,000 bps (32,000 bps desired).

4. Interfaces:

- Automatic secure voice terminals at 16 kbps or 32 kbps
- Netted secure voice at 16 kbps or 32 kbps
- Unit Level Switch on the trunk side for half-duplex secure voice, near real time data, store-forward.

5. Satellite Control Considerations:

- Insofar as possible, any point-to-point and conference call setup and completion should involve only the intended call participants and not the assistance of a third node or centralized control node.

- A dramatic improvement in speed and efficiency should be achieved by the introduction of a multiple access system with automatic signaling.

- The presence of a signalling channel to all multiple access demand assignment operation of satellite channels , which, when coupled with exterior communications system automation techniques will require a minimum of operation intervention in satellite call setup. This should achieve a dramatic reduction in long-haul HF traffic and thus the effort associated with HF management.

- Nets that do not have time-critical information transfer needs can share a common pool of communications capacity.

- TDMA must provide for positive net control features, particularly on secure voice nets, to avoid loss caused by simultaneous transmission of two talkers on half-duplex nets.

- The TDMA modem should be designed and configured for per channel access in the satellite by all users having a common requirement to communicate with each other..

- In Naval use, it is envisioned that carriers, large amphibious ships, and Fleet Escorts would be placed in the same TDMA net in one 25 kHz channel; destroyers, small ships, submarines and patrol aircraft would also be placed in individual TDMA nets in separate 25 kHz channels.

- The TDMA control logic would further provide for the Demand Assignment of any user in any TDMA net depending upon communications requirements. Configuring the TDMA in this manner would allow those users who have the greatest need to communicate with each other to operate in a common TDMA net. Demand assignment would be used to access the common net or any other net to communicate with any other class of users.

- Preliminary stated analysis reveals that a TDMA scheme based upon a maximum of 20 to 30 accesses per 25 kHz channel would be feasible and adequate to satisfy the single/multiple task force naval communications requirements.

6. Systems Tradeoff Analysis:

Systems level analysis should include a cost, feasibility tradeoff analysis on the following TDMA parameters:

- Number of accessing platforms per 25 kHz channel, beginning with 10 and incrementing in steps of 10 up to 40
- Degree of complexity related to per channel TDMA net operations and enter net TDMA operation.
- Size and weight as a function of the TDMA modem and control complexity
- Assessment of the impact of half duplex communications of the TDMA frame, cycle time, and format.

7. Equipment Configurations:

- Land Force Deployments -
  - Manpack
  - Vehicular
- Naval Force Deployments -
  - Shipboard

APPENDIX B

MARTS TECHNOLOGY BASE

1.0 INTRODUCTION

The Mobile Automatic Radio Telephone System (MARTS) operational capabilities is the mobile subscriber of the Mobile Subscriber Access (MSA) subsystem as outlined in the draft TRITAC Subsystem Plan, November 1973. It is recognized that the Army is the proponent service for MSA.

MARTS employs automatically-selected, exclusive channels during a call to transmit and receive communications between addressed subscribers of the system. It also provides the equivalent of an automatic dial radio telephone system with mobility equal to that of units which employ the system. While MARTS is flexible with respect to the number of subscribers that use the system, approximately 1200 mobile telephone users are predicted for a type Division deployment; the number to be deployed in the EAD is to be determined. The Division MARTS offers a 0.95 probability of successful call completion for a normal call, and 0.98 for a priority call, with the time to complete such call not to exceed 8 seconds. Through transmitter automatic power control and receiver gain sensitivity control, MARTS offers efficient use of the frequency spectrum by way of selecting suitable, low-noise, available channels negotiated for each call. A 40 percent loading (off-hook) factor is postulated, pending analysis of the complete INTACS COMSR study. System capabilities are itemized as follows:

- The system provides the capability to transmit and receive secure clear voice, teletypewriter, facsimile, data, and supervisory signals. Communications between users may be on an individual or conference basis.
- Both general and sector warning broadcasts can be made.
- Authorized priority subscribers have the capability to override busy signals, and the called subscriber is notified and given 10 seconds before being preempted.
- Telephone-like voice service is provided, and voice recognition capability is preserved.

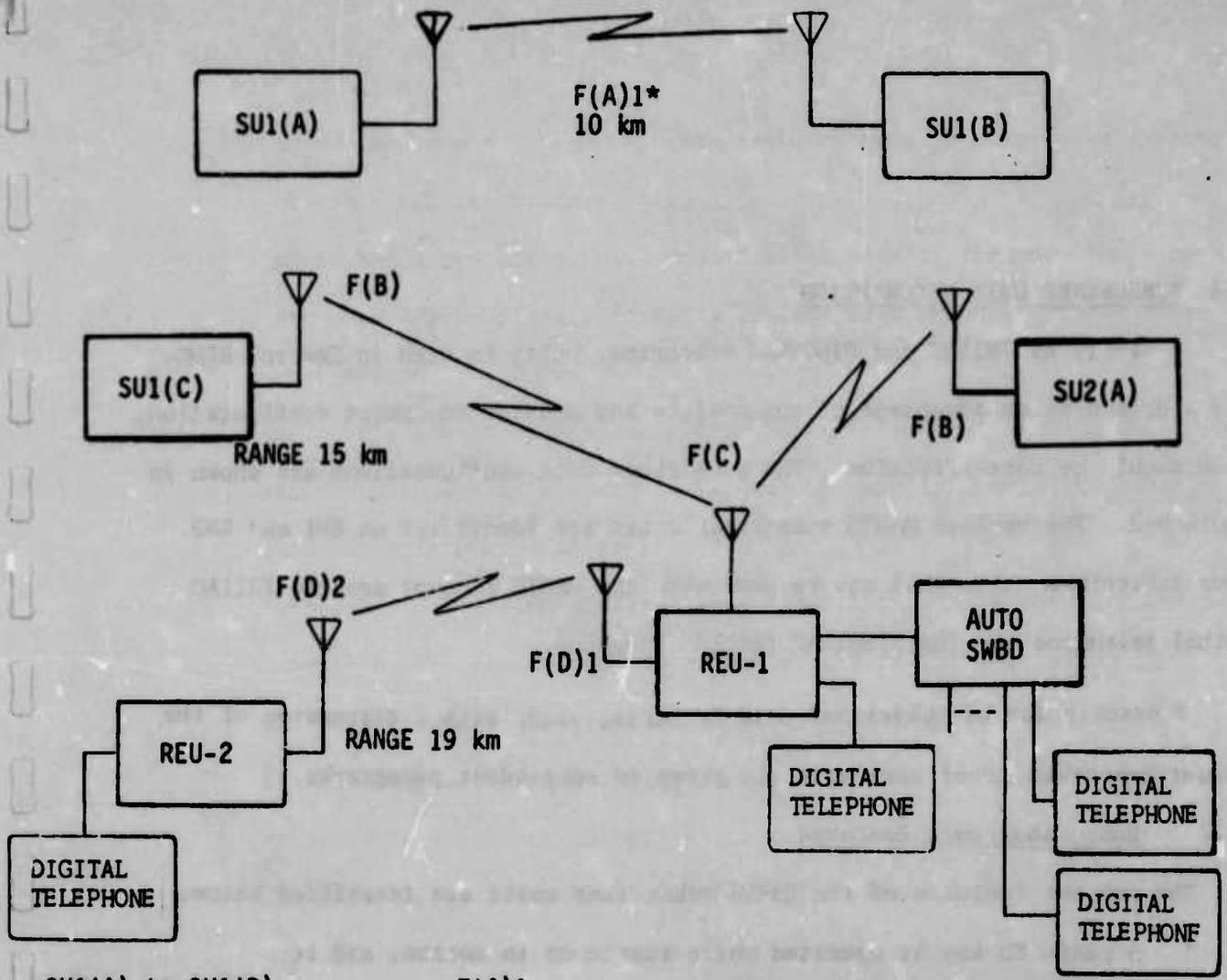
- Data transmissions can be made on a full-duplex basis, providing 10^{-7} error rates at 2400 bps, with an anti-jaming (AJ) capability.
- Conference (net) calls may be set up by a user set with up to seven other subscribers on an individual callup basis, or by signaling (dialing) a prearranged net.
- Modular design permits flexible system and equipment implementation and deployments throughout the Theater Army, the Corps, the Division, and the Separate Brigade.
- The system uses a numbering plan of seven digits, which can be assigned in an ordered (by unit, function) or random manner.
- Continuous service is available to radio subscribers in motion or at a halt.
- The system utilizes digital means for transmission of all types of messages and supervisory signals.
- The system provides sufficient communications channels and addresses to handle requisite user access traffic. Within the bandwidth assigned for use by MARTS, it is possible to lock out channels for use by non-MARTS systems.
- When the call cannot be completed directly between the subscriber sets, the system will automatically switch and route a call through the range extension network for internal calls, or to a larger area trunking and switching system for external Division area calls.
- The system is completely automatic: circuit setup time follows keying of the called number (averaging 3 to 8 seconds, depending upon system loading and the number of relays required to complete the call).
- To assure efficient system operation, the system has the capability to centralize engineering control and status monitoring, through

compilation of data that is available from the REU's processor.

- Functions performed are:
  - Automatic orientation
  - Programmable REU phase-out without interruption of communications
  - Programmable REU phase-in
  - On-line diagnostics
  - Continuous failure status reporting (by schedule or interrogation)
  - Continuous traffic loading status reporting
  - Detailed off-line diagnostics for failure analysis
  - Manual intervention backup.
- The system provides radio and wire digital communications, and will interface with analog switched wire systems and with tactical net radios.
- It is adaptable to interoperation with secure, automatic digital switched system on an automatic digital basis.
- The system will be designed to operate in contiguous frequency bands. The use of these bands, their identification, and their communications ranges are as follows:

Band A	SU-to-SU	10 km
Band B	REU-to-SU	15 km
Band C	SU to REU	15 km
Band D	REU-to-REU	19 km

The A, B, and C bands should be contiguous to minimize equipment complexity. This channelization provides the system with the capability to handle very congested deployment or widely dispersed deployments, and it provides maximum channel lockout flexibility and the greatest antijam capability consistent with economical equipment design (See figure B-1).



SU1(A) to SU1(B) F(A)1

SU1(C) to SU2(A)

SU1(C)/SU2(A) to REU-1	F(B)1
REU-1 to SU1(C)/SU2(A)	F(C)1

DIGITAL TELEPHONE TO SU1(C)

DIGITAL TELEPHONE to REU-1	WIRE
REU-1 to SU1(C)	F(C)2
SU1(C) to REU-1	F(B)2

REU-1 to DIGITAL TELEPHONE

*F(A)1 - Channel 1 of A-Band
F(B) - Channel of B-Band
F(C) - Channel of C-Band

DIGITAL TELEPHONE to SU2(A) WIRE

DIGITAL TELEPHONE to REU-1	WIRE
REU-1 to SU2(A)	F(C)1
SU2(A) to REU-1	F(B)1
REU-1 to DIGITAL TELEPHONE	WIRE

DIGITAL TELEPHONE to DIGITAL TELEPHONE

DIGITAL TELEPHONE to REU-1	WIRE
REU-1 to REU-2	F(D)1
REU-2 to DIGITAL TELEPHONE	WIRE
DIGITAL TELEPHONE to REU-2	WIRE
REU-2 to REU-1	F(D)2
REU-1 to DIGITAL TELEPHONE	WIRE

FIGURE B-1 System User Communications Paths

1.1 SUBSCRIBER UNIT DESCRIPTION

A family of TRITAC and SINCTRAC subscriber units is used in Concept ECHO. This approach takes advantage of commonality and modular equipment configuration, which should be cost-effective. The subscriber unit configurations are shown in figure B-2. The various MARTS subscriber units are identified as SU1 and SU2. Other subscriber units that may be used with the MARTS concept are the TRITAC digital telephone and the SINCTRAC family of radios.

A description of subscriber unit features, along with a discussion of the modular construction of each unit, is given in subsequent paragraphs.

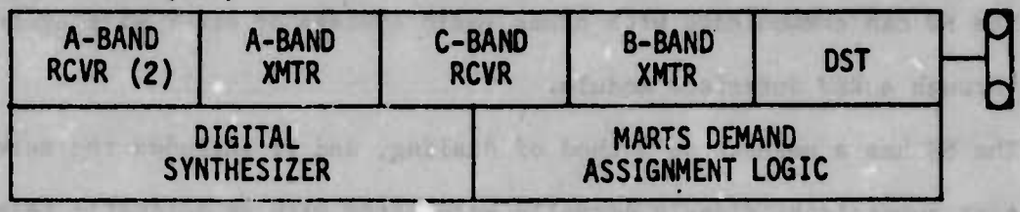
1.1.1 Subscriber Unit Features

The salient features of the MARTS subscriber units are identified below.

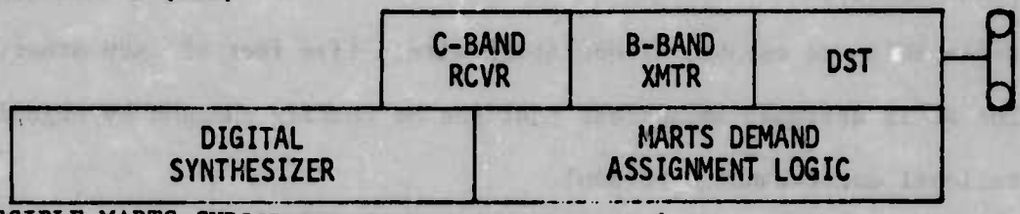
- A radio SU may be operated while static or in motion, and it may be used to transmit supervisory signals, voice, data, teletype, and facsimile messages; it can be used to set up conference calls, and can be enabled to send busy-override and general warning calls.
- SUs may be operated with a vehicular power source, a generator, or a battery (i.e., nominal 28 volts DC; 115/230 volts, 1 phase, 50 to 60 Hz, AC power sources; or an attachable battery).
- Any SU may be operated in the clear or secure mode, through the use of a detachable security device.
- The SU handset is capable of remote operation through the use of a control extension cable.

MARTS SUBSCRIBER UNITS:

SUBSCRIBER UNIT 1 (SU1)



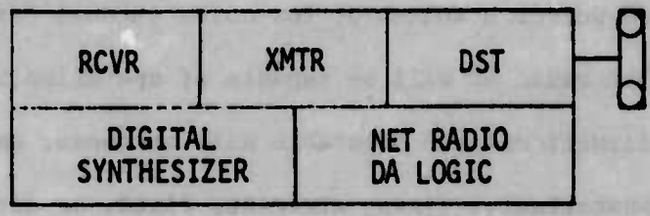
SUBSCRIBER UNIT 2 (SU2)



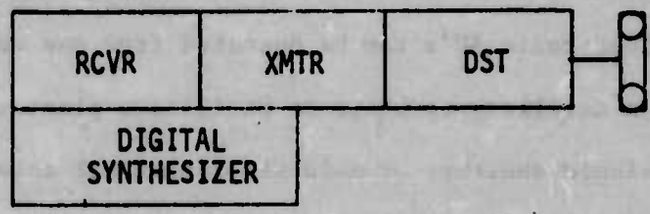
OTHER POSSIBLE MARTS SUBSCRIBER UNIT CONFIGURATIONS:

SUBSCRIBER UNIT [DIGITAL TELEPHONE]

SUBSCRIBER UNIT 4 [SINCTRAC ARWI NET RADIO]



SUBSCRIBER UNIT 5 [SINCTRAC MANPACK NET RADIO]



SUBSCRIBER UNIT [SINCTRAC SQUAD NET RADIO]

FIGURE B-2 Subscriber Unit Modularity for Concept ECHO

- The SU can communicate with other radio systems or other wire systems through a REU interface module.
- The SU has a pushbutton method of dialing, and it includes the necessary supervisory signals normally associated with an automatic telephone system.
- Radio SU's are capable of operating within five feet of each other.
- The SU is assigned an address that can be readily changed by organizational maintenance personnel.
- Subscriber units with a direct mode capability will automatically attempt to contact another SU directly, and if the call cannot be set up, will automatically contact an REU to handle the call.
- The radio SU automatically negotiates with other radio SU's or REU's to select a suitable, low-noise channel for message use.
- The radio SU will be capable of operation with a variety of omnidirectional and steerable null antennas, depending on the type of installation (jeep, aircraft, fixed, or dismounted) and the ECM environment.
- Four radio SU's can be operated from one antenna, through the use of an ancillary combiner to facilitate placement of a group of SU's in a single shelter; or multiple individual antennas may be located 50 feet away from the shelter.
- Some SU's can inititate a callup conference by keying the directory numbers of the desired conferees, and the call will remain set up until one of the two remaining conferees hangs up.
- Either party may terminate a normal call by hanging up.

- The SU provides the call initiator with the capability to press a pushbutton to automatically reestablish an existing call that may become unacceptable due to degraded circuit quality resulting from movement, interference, or jamming.

1.1.2 Equipment Modularity Concept

A major objective of INTACS is the identification of a means of formulating an integrated tactical communications facility for the MRTF. This MRTF communications facility must, as a minimum, have the following salient features:

- High degree of mobility
- High degree of reliability
- Responsiveness to user communications needs
- Fast setup and teardown times
- State-of-the-art packaging concepts
- Digital, all-secure transmissions
- Automaticity of operation
- Commonality of supervisory and message signaling formats
- Equipment building-block concept.

In view of the consideration of both MARTS and SINCTRAC for the mid-range time frame, an opportunity is offered wherein several concepts of equipment modularity may be evaluated to determine the practicability of these concepts. Two of these concepts are presented in subsequent paragraphs. Each concept is premised on the fact that MARTS and SINCTRAC will employ a secure continuously variable slope delta (CVSD); MARTS will accupy a portion of the UHF spectrum, while SINCTRAC will use the existing VHF-FM allocations. Thus, one suggested equipment modularity concept employs the SINCTRAC VHF basic components as MARTS equipment building-blocks, whereas the second concept employs the SINCTRAC UHF basic components as MARTS building-blocks. Each concept will be evaluated within Task V, and the most

cost-effective approach will be selected. The two are summarized as follows:

1.1.2.1 VHF Integrated Equipment Concept

This concept delineates a family of equipment configurations that employ a common digital subscriber unit for use with a switched wire communications system and the proposed family of radio sets. The radio sets are as follows:

- Squad radio, receiver and transmitter
- Manpack
- Portable-vehicular
- Vehicular (receiver/transmitter and receiver)
- Vehicular receiver/transmitter for automatic radio-wire integration (ARWI)
- MARTS access and subscriber unit
- Airborne (VHF-FM and UHF-FM).

Each equipment configuration is depicted in figure B-3.

1.1.2.1.1 Digital Subscriber Terminal

The digital telephone terminal envisioned for usage with the MARTS and SINCTRAC radio sets is operationally compatible with the Digital Subscriber Voice Terminal (DSVT) instrument. The configuration of the digital telephone is portrayed in block diagram form in figure B-3,a. The digital telephone is comprised of a receiver digital telephone terminal module, a transmit digital telephone terminal module, and either of two plug-in hand sets. The two types of handsets proposed for use with the digital telephone are:

- A plain handset (HS) that provides push-to-talk (PTT) operation;
- A supervisory handset (SHS) that has provisions for dialing and controls for initiating control and supervisory functions necessary for call handling within the system in which it is employed. The supervisory signaling and control repertoire of the SHS should encompass all functions of the communications systems in which it

b. DIGITAL SUBSCRIBER TERMINAL

RDST
SHS
TDST

COMMON EQUIPMENT FOR SWITCHED-WIRE AND RADIO COMMUNICATION APPLICATIONS

c. RECEIVER, SQUAD RADIO

R-(SR)	RDST
XTAL LO	SPKR

R_1 = 0.5 km
R_2 = 1.6 km

c. TRANSMITTER, SQUAD RADIO

T-(SR)	TDST
XTAL LO	M

R_1 = 0.5 km
R_2 = 1.6 km

d. RECEIVER/TRANSMITTER, MANPACK

	R-(SR)	RDST
	AUTO LON*	HS
OA-1	T-(SR)	TDST

R = 8.0 km

e. RECEIVER/TRANSMITTER, PORTABLE-VEHICULAR

	R-(SR)	RDST
	AUTO LON*	HS
OA-2	T-(SR)	TDST

R_1 = 8.0 km (mounted)
R_2 = 12.0 km (dismounted)

* - FREQUENCY SYNTHESIZER FOR NET RADIO OPERATION

FIGURE B-3 VHF Integrated Equipment Concept (Sheet 1 of 3)

f. RECEIVER/TRANSMITTER, VEHICULAR-AIRBORNE

	R-(SR)	RDST
	AUTO LO	HS
OA-3	T-(SR)	TDST

R_1 = 24 km (mobile)**
R_2 = 32 km (stationary)**

g. RECEIVER, VEHICULAR

R-(SR)	RDST
AUTO LON	SPKR

R_1 = 24 km (mobile)
R_2 = 32 km (stationary)

h. RECEIVER/TRANSMITTER, VEHICULAR (RWI)

	R-(SR)	RWI DMD ASSIGN LOGIC	RDST
	AUTO LON		SHS
OA-3	T-(SR)		TDST

R_1 = 24 km (mobile)
R_2 = 32 km (stationary)

i. RECEIVER/TRANSMITTER, MARTS ACCESS

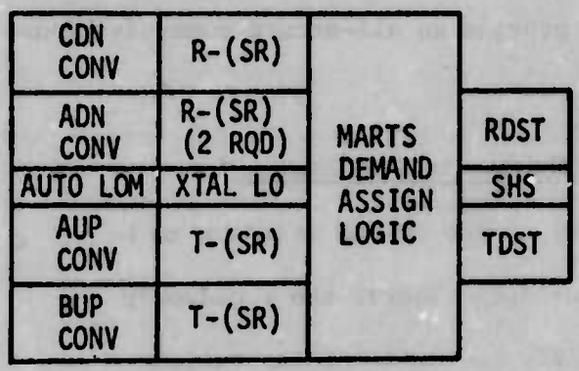
CDN CONV	R-(SR)	MARTS DEMAND ASSIGN LOGIC	RDST
AUTO LOM*	XTAL LO		SHS
BUP CONV	T-(SR)		TDST

R = 15 km (SU-REU-SU)

* - FREQUENCY SYNTHESIZER FOR MARTS OPERATION
** - DOES NOT REFLECT A-A, A-G, or G-A RANGES

FIGURE B-3 VHF Integrated Equipment Concept (Sheet 2 of 3)

j. RECEIVER/TRANSMITTER, MARTS



R_1 = 10 km (SU-SU)
R_2 = 15 km (SU-REU-SU)

k. UHF RECEIVER/TRANSMITTER, AIRBORNE

ABN DN CONV	R-(SR)	RDST
AUTO LOA*	XTAL LO	HS
ABN UP CONV	T-(SR)	TDST

ABN UP CONV HAS TWO CONFIGURATIONS:

V(1) LOW POWER UNIT FOR EMERGENCY APPLICATION
V(2) CONTAINS AN AMPLIFIER FOR NORMAL AIRBORNE OPERATIONS.

* - FREQUENCY SYNTHESIZER FOR AIRBORNE OPERATIONS

FIGURE B-3 VHF Integrated Equipment Concept (Sheet 3 of 3)

will be employed. Further, it is envisioned that a compatible COMSEC device will be GFI, and will provide an all-secure communications capability.

1.1.2.1.2 Receiver/Transmitter (Basic Element in the Concept)

The receiver, squad radio (R-(SR) is the common receiver to be employed within the equipments of this concept. There, the receiver's characteristics and performance must satisfy the needs of its various applications. For squad radio application, it will employ a synthesizer for channel selection. It employs the Vandal COMSEC Module for analog to digital conversion of signals received from the microphone, and includes an amplifier to drive either a speaker or an earpiece (See figure B-3,b.) If the radio is used in the clear text mode only, per recommendation of the Infantry School, there will be a requirement for a second type of analog to digital conversion to make it compatible with the rest of the system.

The transmitter, squad radio (T-(SR)) is the common transmitter, or exciter, element within the equipments of this concept. Its characteristics and performance must satisfy the needs of its various applications. For squad radio application, it will employ a synthesizer for channel selection. It employs the Vandal COMSEC for analog to digital conversion of signals received from the associated microphone (M) (See figure B-3,c.)

1.1.2.1.3 Receiver/Transmitter, Manpack

This radio set requires, in addition to the basic common building-blocks, a fast-response, digitally-tuned frequency synthesizer; an RF amplifier and power supply (OA-1), and a PTT handset (HS) (See figure B-3,d).

1.1.2.1.4 Receiver/Transmitter, Portable-Vehicular

This equipment employs the same basic components as the R/T, manpack, but has a different RF amplifier and power supply (OA-2) that will be used to obtain desired operational capability (See figure B-3,3).

1.1.2.1.5 Receiver/Transmitter, Vehicular-Airborne

The R/T, vehicular-airborne (VHF-FM) employs the same basic components as the R/T, manpack, with the exception of the RF amplifier and power supply (OA-3) that will be used to obtain desired operational capability. (In the airborne application of this radio set, the practicability fo employing the OA-3 must be determined.) (See figure B-3,f.)

1.1.2.1.6 Receiver, Vehicular

This equipment employs the basic components of the squad radio receiver, with the exception of a digitally-controlled frequency synthesizer in place of crystals for channel selection (See figure B-3,g.)

1.1.2.1.7 Receiver/Transmitter, Vehicular (RWI)

This equipment employs the basis components of the R/T, vehicular-airborne radio set, except that demand-assignment logic and appropriate supervisory handset (SHS) are employed for automatic radio-wire integration (ARWI) service via MARTS or the multichannel communications system (See figure B-3,h.)

1.1.2.1.8 Receiver/Transmitter, MARTS Access

This equipment employs the basic R/T manpack components, with the exception of the digitally-controlled frequency snythesizer, which may be replaced by a crystal-controlled oscillator, and the handset, which is could be replaced by the supervisory handset. In addition to these components, up and down-converters are required for B/C-band operation with the REU. The converters are tuned with a single, UHF, digitally-controlled frequency synthesizer for channel selection. MARTS demand-assignment logic is incorporated to perform the automatic call-processing capability; in addition, it exercises control of the frequency synthesizer (See figure B-3,i.)

1.1.2.1.9 Receiver/Transmitter, MARTS Subscriber Unit

The MARTS subscriber unit employs the components of the MARTS access unit, plus a second digitally-controlled frequency synthesizer and up- and down-converters for A-band (direct mode) operations. The demand-assignment logic is capable of automatically processing direct or access mode calls (See figure B-3,j).

1.1.2.1.10 UHF Receiver/Transmitter, Airborne

This equipment employs the same basic components as the R/T manpack, with the exception of the digitally-controlled frequency synthesizers, which is replaced by a crystal-controlled oscillator; also, the OA-1 is deleted. Additional components required are up- and down-converters and the associated digitally-controlled frequency synthesizer for UHF airborne operations. The up-converter may require two different power outputs: one for emergency applications and one solely for airborne operations (See figure B-3, k).

1.1.2.2 UHF Integrated Equipment Concept

Within this concept, the UHF airborne equipment is the basic building-block for the airborne R/T and the MARTS equipments. This approach is to be investigated, since MARTS employs portions of the UHF spectrum. Implementation of the VHF-FM family of equipments of the VHF concept is applicable to this concept. Equipment configurations for the UHF concept for airborne and MARTS equipments are depicted in figure B-4.

1.1.2.2.1 UHF Receiver/Transmitter, Airborne (Handheld)

For this application, a separate UHF receiver and transmitter, which have the characteristics and performance required to satisfy the airborne and MARTS equipment operational requirement, are envisioned. In addition, this configuration employs two common voice processing equipments, as specified in the VHF concept (See figure B-4,a).

a. UHF RECEIVER/TRANSMITTER, AIRBORNE (HANDHELD)

R-(ABN)	RDST
AUTO LOA	HS
T-(ABN)	TDST

b. UHF RECEIVER/TRANSMITTER, AIRBORNE

	R-(ABN)	RDST
	AUTO LOA	HS
OA-4	T-(ABN)	TDST

c. RECEIVER/TRANSMITTER, MARTS ACCESS

ACDN CONV	R-(ABN)	MARTS DEMAND ASSIGN LOGIC	RDST
AUTO LOMA	XTAL LOA		SHS
ABUP CONV	T-(ABN)		TDST

R = 15 km (SU-REU-SU)

d. RECEIVER/TRANSMITTER, MARTS

ACDN CONV	R-(ABN)	MARTS DEMAND ASSIGN LOGIC	RDST
AADN CONV	R-(ABN) (2 RQD)		SHS
AUTO LOMA	XTAL LOA		TDST
AAUP CONV	T-(ABN)		
ABUP CONV	T-(ABN)		

R_1 = 10 km (SU-SU)
R_2 = 15 km (SU-REU-SU)

FIGURE B-4 UHF Integrated Equipment Concept

1.1.2.2.2 UHF Receiver/Transmitter, Airborne

This radio set employs the basic components of the airborne (handheld) unit, with the incorporation of an RF amplifier and a power supply (OA-4) to obtain the desired operational range. (See figure B-4,b.)

1.1.2.2.3 Receiver/Transmitter, MARTS Access

The same approach is employed in this concept as that used in the VHF concept; however, in this case, the translation problem is lessened, due to frequency differences between the UHF and VHF intermediate frequencies (See figure B-4,c.)

1.1.2.2.4 Receiver/Transmitter, MARTS Subscriber Unit

The MARTS subscriber unit employs the components of the MARTS access unit, plus a second digitally-controlled frequency synthesizer and up- and down-converters for A-band (direct mode) operations. The demand-assignment logic is capable of automatically processing direct or access mode calls (See figure B-4,d.)

1.2 | RANGE EXTENSION UNIT

A range extension unit (REU) is employed within MARTS for the purposes of providing users within its service area with the following:

- An automatic local area radio relay call facility
- An automatic call routing facility (REU-to-REU, and/or multiple REU) for total area system coverage
- An automatic interface capability
- A control processor capable of performing automatic call processing functions, orienting an REU into the system, performing diagnostics and forwarding the status to other REU's, and performing system control functions on a distributed basis.

Identification of REU functions and a discussion of the REU's configuration appears in subsequent paragraphs.

1.2.1 Range Extension Unit Features

The salient features of the MARTS REU are identified below:

- The REU provides secure or clear radio frequency transmission with radio SU's and other REU's, and secure or clear wire transmission with digital telephone SU's.
- An REU controls the setup of calls that cannot be established in the SU-to-SU direct mode. It attempts to establish a call through a single, REU, either itself or another REU. If this is not successful, it will continue to control the call until the call is set up through a multi-REU link, or until the call is routed to a large area trunking and switching system.
- The REU will conduct negotiations with radio SU's to select suitable channels to be used for message traffic.
- The REU may be operated independently as a single-channel access subsystem or as part of a multi-REU network interconnected with trunking and switching systems. In the multi-REU deployment, it automatically orients itself into and de-orients from the network (i.e., it exchanges information with other REU's in the network, and establishes a routing matrix in its memory from which it can determine all signaling routes to other REU's in the network and current REU-to-SU contact capabilities). Information is updated during REU operation following orientation.
- The REU will have sufficient reliability, self-test, diagnostics, and modular construction to assure 99 percent operational availability of at least one channel.

- The REU has the capability to interface with TACSAT and multichannel systems.
- The REU will be capable of full operation within 30 minutes after arrival at a new site, including erection of antennas, insertion of programmed information, and completion of orientation into the REU network.
- The REU will provide to a central point all information necessary to control and engineer the system, including operational status of REU's and traffic data.
- The REU will have a manual intervention capability, to provide a means whereby it can continue to function in the presence of certain types of failures.

1.2.2 Description of Range Extension Unit

The REU assemblage and its interrelationship with surrounding MARTS equipments and other INTACS communications facilities is illustrated in figure B-5. Each sub-element is described as follows:

- Local radio facilities provide C-band receivers for the reception of requests for local area service from users within its local service area, B-band transmitters for transmitting replies to users requesting service, and transmissions to users within its local area for callup purposes. Incorporated are the video processors for message and supervisory signal processing at either 16 or 32 kbps rates. The number of transmitters and receivers to be employed cannot be determined until a MARTS traffic analysis of the INTACS COMSR's has been completed. The interconnection of the local radio components with other intercentral, interface, and other communications input/output ports is accomplished by the automatic switch/cross-connect facility under processor control.

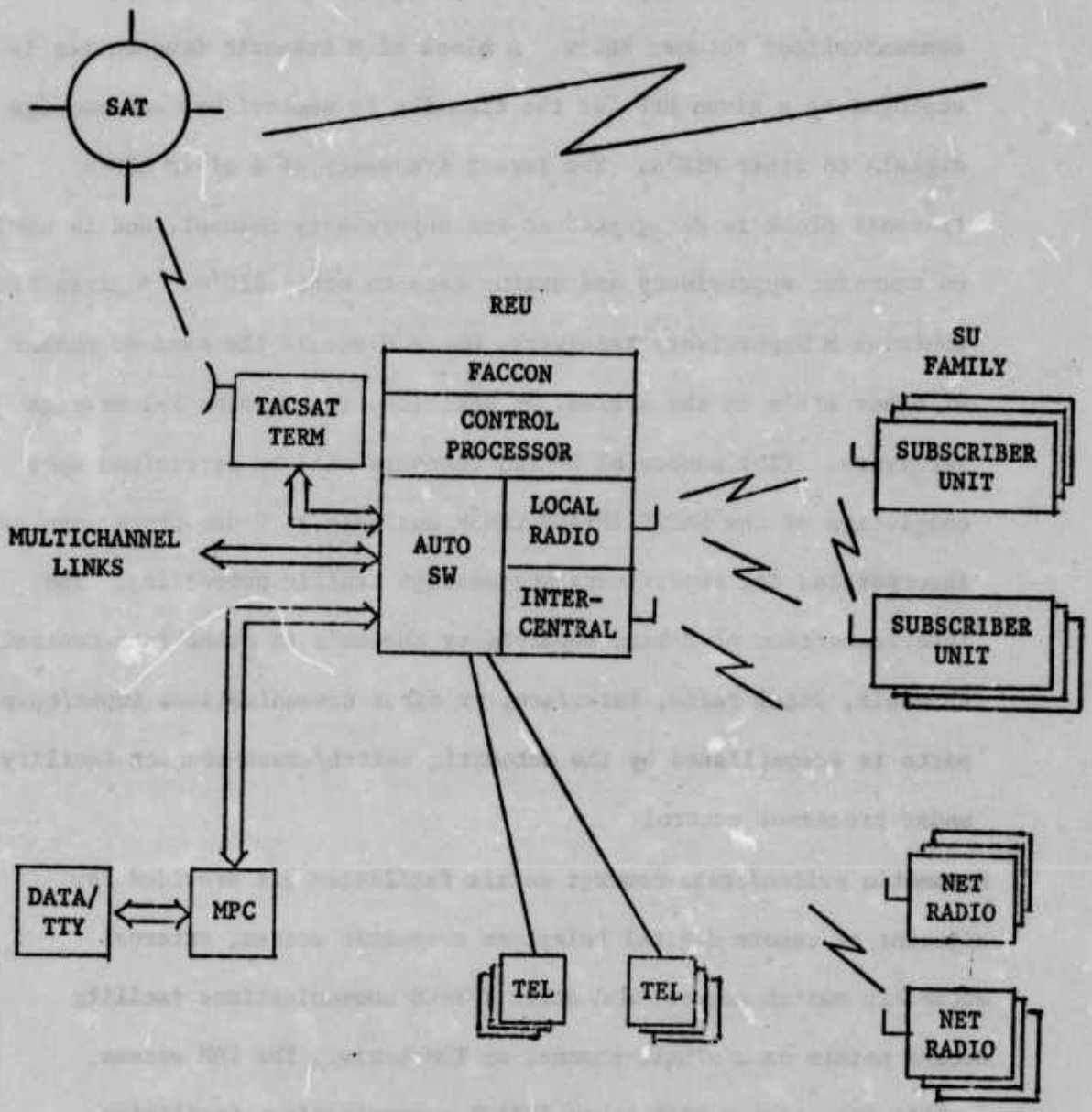


FIGURE B-5 REU Block Diagram and Communication Interrelationship

Transmissions to and from users at an REU are accomplished on a B-C channel pair (25/50 kHz spacing) adaptively selected by the REU.

- Intercentral D-band facilities are provided for multichannel communications between REU's. A block of N transmit frequencies is employed by a given REU for the transfer fo supervisory and message signals to other REU's. The lowest frequency of a given REU's transmit block is designated as its supervisory channel, and is used to transfer supervisory and status data to other REU's. A given REU contains M supervisory receivers, where M equals the maximum number of other REU's in the system. In addition, it contains N-1 message receivers. (The number of D-band channels will be determined upon completion of the MARTS INTACS COMSR analysis.) Video processors are incorporated for supervisory and message traffic processing. The interconnection of D-band supervisory channels to other intercentral channels, local radio, interface, or other communications input/output ports is accomplished by the automatic switch/cross-connect facility under processor control.

- Automatic switch/cross-connect matrix facilities are provided for adjacent or remote digital telephone automatic access, external automatic switch access, and other INTACS communications facility access points on a single-channel or TDM basis. The TDM access permits interfacing with other INTACS communications facilities, high speed serial data buffer (HSSDB) with ATACS or TACSAT equipments. Once accessed by an external MARTS user, the automatic switch/cross-connect matrix causes the appropriate connections to be made in the REU.

- Control processor facilities are provided in the REU for automatic call processing, self-test, and status-reporting. A minicomputer is adequate as the processor for this application.
- System control (SYSCON) facilities, consisting of displays and appropriate control panel, are provided at the REU.

1.3 MARTS ALTERNATIVES

Within the MARTS concept there are several communications options offered in terms of system, equipment design, and the application of these communications capabilities. Past developments combined with advancements in technology make the design and the production of the MARTS concept, with its options, low risk. However, to assure that the concept contains the most cost effective mix of options and capabilities, a detailed evaluation of MARTS must be accomplished in the INTACS Task V or subsequent design phases. The alternatives to be considered are identified in subsequent paragraphs.

1.3.1 System Design Considerations

System design trades that must be performed in INTACS Task V are as follows:

- 16 vs 32 kbps data rate. The selection of the data rate for MARTS is assumed to be 16 kbps. The final selection of the MARTS data rate must be made in concert with the selection of data rates for the next generation automatic switched system, TACSATCOM and TRCS. This will be addressed in INTACS Task V.
- Frequency-division vs TDM links. The means of implementing the rf link for interconnecting REU's and for communications between REU's and SU's has a great impact on system performance and equipment design and cost. MARTS currently proposes TDM links between REU's, and FDM techniques for communications between REU's and SU, and for communications between SU's. This trade-off will be addressed in INTACS Task V. The final

selection of the preferred scheme should be accomplished in the MARTS system design phase.

- VHF vs UHF spectrum utilization. For the sake of equipment commonality it would be ideal if TRCS and MARTS occupied the same frequency spectrum. This is impractical from the standpoint of the present crowding of the VHF spectrum by net radio; but with the introduction of TRCS equipments, this spectrum crowding may be minimized and coexistence of the two systems should be considered. The MARTS concept presented herein proposes to use a portion of the frequency spectrum from 350 to 400 mHz. This solution is logical since the AN/GRC-103 radio uses this same portion of the frequency spectrum, and its use within the division area is being negated with the introduction of the Division MARTS. The final selection of the frequency spectrum used by MARTS depends upon the frequency allotted to the Army for this purpose.
- Security. The MARTS digital telephone is the TRITAC digital telephone, and as such should be compatible with other communications systems employing similar devices. At present, MARTS proposes the use of security equipments to meet the COMSR security requirements. Other aspects of security to be considered in INTACS Task V are partial vs total security (NSA goal) and its impact in terms of cost and performance.
- Tactical Communications Control Facility (TCCF) for ECHO. The MARTS REU has built-in test equipment which permits self-test and evaluation, plus a means of status reporting between all REU's in the system. These capabilities provide the basic tools necessary for implementing an automated form of system control. Within INTACS Task V, the TCCF concept will be formulated for the division and for

the application of MARTS in the EAD.

- Equipment Modularity concept proposed herein will be evaluated in INTACS Task V. This concept not only affects the manner in which the equipments are used through equipment commonality, but total life-cycle-costs as well.

1.3.2 MARTS Alternative Applications

In regard to MARTS application, some alternatives must be evaluated within INTACS Task V to assure the selection of the most cost-effective mix of communication options within the finalized MARTS concept. The following summary of Concept CHARLIE MARTS for the separate and divisional brigades command posts and two alternatives to this concept are presented as follows.

1.3.2.1 Concept CHARLIE MARTS

Within Concept CHARLIE MARTS will replace formerly employed equipment and personnel as follows:

- Switched wire system and
  - AN/TTC-29
  - SB - 22
  - SB - 86
- AM/FM admin/log radio nets within the separate and divisional brigades and lower units
- In the separate brigade, wire interconnection of the digital telephone devices, directly to their supporting REU would result in reducing the currently authorized wire equipment and personnel by approximately one-half.
- Retention of SB-993 for perimeter defense.

A comparison of personnel and equipment reductions in Concept CHARLIE and Concept ALPHA appears in Table B-1.

TABLE B-1

SUMMARY OF COMMUNICATION SUPPORT FOR CONCEPT MARTS AND ALTERNATIVES

EQUIPMENT ITEM	CONCEPT ALPHA	CONCEPT CHARLIE	ALTERNATIVE ONE	ALTERNATIVE TWO
WD-1	451	276	9	0
Wireman, MOS 36k	148	69	9	0
SB-22	44	0	0	0
SB-86	3	0	0	0
AN/TTC-29	1	0	0	0
SB-993	19	30	30	30
Digital Telephone		65	65	0
SU-2		0	0	65
REU		5	5	5
REU O&M Personnel		25	40	25

The first alternative to Concept CHARLIE is the removal of a portion of the REU cross-connect matrix, i.e. that portion of the matrix that performs the switching function and is considered to be a unit level switch (ULS), and locating it within the command post (CP) area. Additionally, an rf link interconnects the switch to the REU. See table B-1 for reduction of personnel and equipments when applying this alternative to Concept CHARLIE.

The second alternative to Concept CHARLIE is the replacement of the digital telephone with SU2. The SU2 has direct access with an REU. Table B-1 reflects the savings in personnel and equipments obtainable with this alternative.

1.3.2.2 Other Alternatives

The results of the above analysis show that other options of MARTS should be considered and evaluated in INTACS Task V. These alternatives are identified as follows:

- An REU design in which the REU is housed in two 1¼ - ton shelters instead of one. This partitioning would provide one unit capable of providing local area service, whereas the second unit would provide a communications capability for the interconnection of local area service units. Unit 1 is ideally configured for applications in the EAD.
- A design in which a small capacity, low powered MARTS is used for wireless CP communications. In this application a low power R/T subscriber unit (50 to 1500 meter range) provides a TDM communications link to the Static Access Unit (SAU). The SAU is essentially a ULS. Additionally, an rf link would be employed for interconnecting the SAU to the REU.

APPENDIX C

INTACS C-E ASSETS

APPENDIX C

INTACS C-E ASSETS

The attached list of C-E Assets with "X" in the columns denotes which assets will be employed for each Candidate Design at each echelon.

The equipments authorized for use in the ALPHA design are extracted from current TOE (1 October 1974). The otherwise-approved assets for ALPHA are marked with the annotation "A" appearing before the entry on the listing.

Equipment nomenclature annotated with an asterisk indicates that these equipments contain TD-1065 and TD-1069 multiplexers.

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	F	A	B	C	E	A	B	C	E
MULTICHANNEL TRANSMISSION FACILITIES:																
LOW CAPACITY:																
AN/MRC-127 - RADIO TERMINAL SET (Dual 12 chan)					X	X	X		X	X	X	X	X	X	X	X
AN/TRC-113 - RADIO REPEATER SET					X				X				X			
AN/TRC-145 - RADIO REPEATER SET						X	X			X	X	X		X	X	X
AN/TRC-145*- RADIO REPEATER SET		X				X				X	X	X		X	X	X
V/D/T TERMINAL (INCLUDES RT-(GARS))																
MEDIUM CAPACITY:																
AN/TRC-110 - RADIO REPEATER SET (REPLACED BY TRC-152)																
AN/TRC-117 - RADIO TERMINAL SET (REPLACED BY TRC-151)																
AN/TRC-117*- RADIO TERMINAL SET (REPLACED BY TRC-151*)																
AN/TRC-151 - RADIO TERMINAL SET									X				X			
AN/TRC-151*- RADIO TERMINAL SET										X	X	X		X	X	X
AN/TRC-152 - RADIO REPEATER SET									X	X	X	X	X	X	X	X
AN/TRC-(IV)- RADIO TERMINAL SET						X	X			X	X	X		X	X	X
HIGH CAPACITY:																
AN/TRC-138 - RADIO REPEATER SET									X	X	X	X	X	X	X	X
SHORT RANGE WIDE BAND RADIO (SRWBR) GRC-144M											X				X	
MULTICHANNEL KEYING SYSTEM										X				X		
AN/GRC-( ) RADIO TERMINAL SET (DTH)												X				X

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
TROPO:																
AN/TRC-112 - RADIO TERMINAL SET LIGHT TROPO									X	X			X	X		
AN/TRC-121 - RADIO TERMINAL SET LIGHT TROPO									X	X						
AN/TRC-132A-RADIO TERMINAL SET HEAVY TROPO													X			
AN/TRC-(DT)-TACTICAL DIGITAL TROPO												X				X
TACSAT:																
AN/TSC-(S) SHF RADIO TERMINAL SET, LOW CAP								X				X				X
AN/TSC-(M) SHF RADIO TERMINAL SET, MED CAP												X				X
AN/TSC-(L) SHF RADIO TERMINAL SET, LARGE CAP												X				X
AN/MSC-59 - RADIO TERMINAL SET, SHF						X	X									
AN/TSC-85(V)1 - RADIO TERMINAL SET, SHF										X	X			X	X	
AN/TSC-85(V)2 - RADIO TERMINAL SET, SHF										X	X			X	X	
ACCESS:																
AN/MRC-(M) MARTS RANGE EXTENSION UNIT			X	X			X	X				X				X
AN/MRC-(A) MARTS MOBILE ACCESS UNIT (B/C BAND)												X				X
AN/MRC-(S) MARTS SUB ACC UNIT (LIMITED CAP)												X				X
R/T-(M) MARTS D-BAND ACCESS UNIT												X				X

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END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
RADIO TERMINAL FACILITIES:																
A AN/TSC-18 - COMMUNICATIONS CENTRAL (REPLACES TSC-19)													X	X	X	X
AN/TSC-20 - COMMUNICATIONS CENTRAL													X	X	X	X
AN/TSC-38 - COMMUNICATIONS CENTRAL																
TELEPHONE TERMINAL FACILITIES:																
AN/TCC-11 - TELEPHONE REPEATER																
AN/TCC-29 - TELEGRAPH/TELEPHONE TERMINAL	X	X			X	X	X		X	X		X	X	X	X	
AN/TCC-61 - TELEPHONE TERMINAL (8-12 CHAN GRPS.)									X				X			
AN/TCC-61*- TELEPHONE TERMINAL (8-12 CHAN GRPS.)										X				X	X	X
C-5 AN/TCC-62 - TELEPHONE TERMINAL																
AN/TCC-65 - TELEPHONE TERMINAL (QUAD 12 CHAN.)					X				X				X			
AN/TCC-65*- TELEPHONE TERMINAL (QUAD 12 CHAN.)						X				X				X	X	X
AN/TCC-69 - TELEPHONE TERMINAL (DUAL 12 or SING 24 ch.)									X				X			
AN/TCC-69*- TELEPHONE TERMINAL (DUAL 12 or SING 24 ch.)														X		
AN/TCC-72 - TELEPHONE TERMINAL (DUAL 12 chan.)									X							
AN/TCC-72*- TELEPHONE TERMINAL (DUAL 12 chan.)										X						
AN/TCC-73(V)1- TELEPHONE TERMINAL (DUAL 48 or 96 ch.)																
AN/TCC-73(V)1*-TELEPHONE TERMINAL (DUAL 48 Or 96 ch.)										X				X	X	X
AN/TCC-73(V)2 -TELEPHONE TERMINAL (QUAD 12 or 24 ch.)									X				X			
AN/TCC-73(V)2*-TELEPHONE TERMINAL (QUAD 12 or 24 ch.)										X				X		
A - APPROVED FOR CANDIDATE ALPHA /NON-TOE ITEM																

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
MULTIPLEXING FACILITIES:																
TD-352 12 chan } CONFIGURED																
TD-353 48 chan } COMPONENTS																
TD-660 6/12 chan } COMPONENTS					X	X	X		X	X	X		X	X	X	X
DIGITAL GROUP MULTIPLEXERS											X	X				X
TD-1065( )G SERIAL DATA BUFFER (12 chan)						X				X	X			X	X	X
TD-1069( )G TIME DIVISION DATA MULTIPLEX						X				X	X			X	X	X
TD-982 PULSE FORM RESTORER										X	X			X	X	X
TD-976 ASYNCHRONOUS DIGITAL COMBINER (8-12 GRPS)										X	X			X	X	X
TD-202 12/24 CHAN									X	X	X		X	X	X	X
TD-203 48/96 CHAN																
TD-204 12/24/48 CHAN) CONFIGURED																
TD-754 6/12/24 CHAN) COMPONENTS					X	X			X	X	X		X	X	X	X
TD-206 PULSE FORM RESTORER					X	X			X	X	X		X	X	X	X
TD-206G PULSE FORM RESTORER, IMPROVED					X	X			X	X	X		X	X	X	X
CV-425 - TELEGRAPH, TELEPHONE SIGNAL CONVERTER									X	X	X		X	X	X	X
CV-1548- TELEPHONE SIGNAL CONVERTER					X	X			X	X	X		X	X	X	X
A CV-1918- CONVERTER TELEPHONE SIGNAL	X	X			X	X			X	X	X		X	X	X	
A CV-1919- CONVERTER TELEPHONE SIGNAL	X	X			X	X			X	X	X		X	X	X	
A - APPROVED FOR CANDIDATE ALPHA /NON-TOE ITEM																

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
SWITCHING FACILITIES:																
AN/MTC-1 - TELEPHONE CENTRAL OFF, MANUAL									X	X			X	X		
AN/MTC-1A- TELEPHONE CENTRAL OFF, MANUAL									X	X			X	X		
AN/MTC-3 - TELEPHONE CENTRAL OFF, MANUAL REPL W/TTC-23																
AN/MTC-7 - TELEPHONE CENTRAL OFF, MANUAL REPL W/TTC-29																
AN/MTC-9 - TELEPHONE CENTRAL OFF, MANUAL													X			
AN/MTC-10- TELEPHONE CENTRAL OFF, GROUP																
AN/MYQ-2-TACT AUTO DIGITAL SWITCH																
AN/TTC-23 - TELEPHONE CENTRAL OFF, MANUAL													X	X	X	
AN/TTC-29 - TELEPHONE CENTRAL OFF, MANUAL									X	X			X	X	X	
A AN/TTC-35(V)1, TELEPHONE CENTRAL OFF, MAN CONF OF SB-3082	X				X	X				X				X	X	
A AN/TTC-35(V)2, TELEPHONE CENTRAL OFF, MAN					X	X				X				X	X	
A AN/TTC-38(V)1, AUTOMATIC SWITCHBOARD (15)									X	X				X	X	X
A AN/TTC-38(V)2, AUTOMATIC SWITCHBOARD (2)										X			X	X	X	X
AN/TTC-39(V)1, AUTOMATIC SWITCHBOARD											X	X				X
AN/TTC-39(V)2, AUTOMATIC SWITCHBOARD											X	X				X
AN/TTC-(A)V1 - 75 LINE AUTO SWITCHBOARD											X	X				X
AN/TTC-(A)V2 -150 LINE AUTO SWITCHBOARD											X	X				X
AN/TTC-(C)V1 - 15 LINE AUTO SWITCHBOARD												X				X
AN/TTC-(C)V2- 30 LINE AUTO SWITCHBOARD											X	X				X
AN/TTC-(C)V3 - 60 LINE AUTO SWITCHBOARD											X	X				X
SB-22 TELE SWBD, MANUAL	X	X			X	X	X		X	X	X		X	X	X	
SB-86 - TELE SWBD, MANUAL	X				X				X				X			
SB-993 - TELE SWBD, MANUAL	X				X				X	X			X	X		
A SB-3082 - TELE SWBD, SEMI-AUTO (1LO-SB-86)(176)	X				X					X				X	X	
A - APPROVED FOR CANDIDATE ALPHA /NON-TOE ITEM																

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END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
SWITCHING FACILITIES (CONT.):																
SB-3614(A) - TELE SWBD, AUTO 30 LINE		X				X	X									
SB-3614(A) - TELE SWBD, AUTO 60 LINE		X				X	X									
SB-3614(A) - TELE SWBD, AUTO 90 LINE						X	X									
TA-207 - SIGNAL ASSY, SWITCHBOARD									X				X			
QUERY CONTROL STATION			X				X	X			X	X			X	X
QUERY CONTROL STATION (IMPROVED) QCS-(M)				X				X				X				X

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
COMM SYS PLAN, ENG, & CONT (TCCF):																
SYSTEMS CONTROL FACILITIES:																
AN/MSC-25 - COMM OPNS CENTER									X				X	X	X	X
AN/MSC-31 - COMM OPNS CENTER					X				X				X	X	X	X
AN/MSC-(P) SYSTEM CONT. FACILITY (TCCF)						X				X				X	X	
AN/MSC(I/O)SYSTEM CONT. FACILITY (TCCF)		X				X				X				X	X	
TCCF (CSPE/CSCE)							X	X			X	X				X
AN/MSQ-73 COMM TECH CONT. FACILITY													X			
STORE & FORWARD MODULE 50 LINE											X	X				X
S & F MODULE 100 LINE																
FACILITIES CONTROL FACILITIES:																
AN/MSC-32 OPNS CENTRAL									X				X	X	X	X
DATA ADAPTER							X				X					X
TCCF (CNCE)							X	X			X	X				X
TECHNICAL CONTROL FACILITIES:																
AN/TSC-76 PATCHING CENTER					X	X	X		X				X			
AN/TSQ-(84A) TECH CONT FAC (IMPROVED)										X				X	X	
AN/TSQ-(D) DATA/TTY TECH CONT. FACILITY																
AN/TSQ-(S) TECH CONT. FAC. (SMALL)																
AN/TSQ-85 VIDEO TECH CONT. FAC.										X				X	X	

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
TECHNICAL CONTROL FACILITIES (CONT.):																
J-1077A/U DISTRIBUTION BOX					X	X			X	X			X	X	X	X
SB-611/MRC PATCH PANEL (REPLACED BY TSC-76)																
SB-675/MSC PATCH PANEL									X				X			
TCCF (CESE)							X	X			X	X				X

	END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
		A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
	SINGLE CHANNEL ACCESS:																
A	C-6709/G RADIO SET CONTROL		X				X			X	X			X	X		
	AN/GRA-39 RADIO SET CONTROL GROUP	X	X	X		X	X	X		X	X	X		X	X	X	
	AN/GRA-74 RADIO SET CONTROL GROUP	X	X	X		X	X	X		X	X	X		X	X	X	
	AN/GSA-7 RADIO SET CONTROL	X				X				X				X			
	AN/GSA-( ) SINCGARS ARWI		X				X				X				X		
	AN/VRC-49 VHF/FM RADIO SET	X				X				X				X			
	AN/VRC-( ) SINCGARS ARWI		X	X			X	X			X	X			X	X	
	AN/VRC-(S1) MARTS SUBSCRIBER UNIT 1			X	X			X	X				X				X
	AN/VRC-(S2) MARTS SUBSCRIBER UNIT 2				X				X				X				X
	AN/VRC-( ) MARTS/SINCGARS RAD SET, ARWI				X				X				X				X
	GSA-(C) TRITAC OPTION 7			X				X				X				X	
	GSA-(A) TRITAC OPTION 10				X				X				X				X
	A - APPROVED FOR CANDIDATE ALPHA /NON-TOE ITEM																

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
SINGLE CHANNEL TRANS. FACILITIES:																
AN/URC-68 PERSONAL EMERGENCY TRANSCEIVER		X	X	X		X	X	X		X	X	X		X	X	X
AN/GRC-106 HF/SSB RADIO SET	X	X	X		X	X	X		X	X	X		X	X	X	
AN/GRC-122 HF/SSB RADIO SET					X	X	X		X	X	X		X	X	X	
GRC-122 (V)2 HF/SSB RADIO SET/AMP						X	X			X	X			X	X	
AN/GRC-125 VHF/FM RADIO SET					X				X				X			
AN/GRC-142 HF/SSB RADIO SET	X	X	X		X	X	X		X	X	X		X	X	X	
AN/GRC-160 VHF/FM VEHICULAR RADIO SET	X				X				X				X			
AN/MRR-8 RADIO RECEIVER SET													X	X	X	
AN/MRT-9 RADIO TRANSMITTER SET													X	X	X	
AN/PRC-41 UHF/AM ATC					X	X	X									
AN/PRC-74 HF/SSB RADIO SET									X	X	X		X	X	X	
AN/PRC-77 VHF/FM RADIO SET	X				X				X				X			
AN/PRC-( ) SINCGARS VHF/FM RADIO SET		X	X			X	X			X	X			X	X	
AN/VRC-12 VHF/FM RADIO SET	X				X				X				X			
AN/VRC-( ) SINCGARS VHF/FM RADIO SET		X	X			X	X			X	X			X	X	
AN/VRC-46 VHF/FM RADIO SET	X				X				X				X			
AN/VRC-( ) SINCGARS VHF/FM RADIO SET		X	X			X	X			X	X			X	X	
AN/VRC-47 VHF/FM RADIO SET	X				X				X				X			
AN/VRC-( ) SINCGARS VHF/FM RADIO SET		X	X			X	X			X	X			X	X	
AN/VRC-48 VHF/FM RADIO SET									X							
AN/VRC-( ) SINCGARS VHF/FM RADIO SET										X	X					
AN/PRC-90 RADIO SET	X	X	X		X	X	X						X	X	X	
AN/PRR-9 RADIO RECEIVING SET	X				X				X				X			
AN/PRT-4 RADIO TRANSMITTING SET	X				X				X				X			
AN/URC-10 RADIO SET					X	X	X		X	X	X		X	X	X	

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
SINGLE CHANNEL TRANS. FACILITIES (CONT.):																
AN/VSC-2 RADIO TELETYPEWRITER SET					X	X	X		X	X	X		X	X	X	
AN/VSC-3 RADIO TELETYPEWRITER SET					X	X	X						X	X	X	
AN/VRC-24 UHF/AM ATC VEH MTD RAD SET					X	X	X		X	X	X		X	X	X	
AN/VRC-53 VHF/FM RADIO SET																
AN/VRC-64 VHF/FM RADIO SET	X				X				X				X			
AN/VRC-( ) SINCGARS (REPLACES GRC-160 and VRC-64)		X	X			X	X			X	X			X	X	
R-390/URR RADIO RECEIVER									X	X	X		X	X	X	
AN/FRC-93 HF/SSB TRANSCEIVER													X	X	X	
AN/VRC-54 VHF/FM RADIO SET	X	X	X		X	X	X		X	X	X		X	X	X	
AN/VRC-( ) MARTS/SINCGARS RAD SET, MANUAL				X				X				X				X
AN/PRC-68 USMC RADIO (HAND HELD)		X	X	X		X	X	X		X	X	X		X	X	X
AN/PRC-66 USAF AIR GROUND RADIO (PATH FINDER)			X	X			X	X			X	X			X	X
AN/GSC-(DA) DA TDMA TACSAT UHF TERMINAL				X				X				X				X
AN/MSC-(DA) DA TDMA TACSAT UHF TERMINAL				X				X				X				X
AN/PSC-(DA) DA TDMA TACSAT UHF TERMINAL				X				X				X				X
R/T-(DA) DA TDMA TACSAT UHF TERMINAL				X				X				X				X
GSC-(SATS) S/C TACSAT RATT, FDMA, UHF		X	X			X	X			X	X			X	X	
MSC-(SATS) S/C TACSAT TERM, FDMA, UHF, 1/4 TON		X	X			X	X			X	X			X	X	
PSC-(SATS) S/C TACSAT MANPACK TERM, FDMA, UHF		X	X			X	X			X	X			X	X	
RT-(SATS) S/C REVR & ANTENNA TERM, FDMA, UHF		X	X			X	X			X	X			X	X	
AN/TSC-61 - FLIGHT COORDINATION CENTRAL					X	X	X	X								
AN/TSQ-70 - AIRCRAFT CONTROL CENTRAL					X	X	X	X	X	X	X	X	X	X	X	X
AN/TSQ-71 - LANDING CONTROL CENTRAL					X	X	X	X	X	X	X	X	X	X	X	X

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
SINGLE CHANNEL TRANS. FACILITIES (CONT.):																
AN/ARC-102 RADIO SET	X	X	X		X	X	X		X	X	X		X	X	X	
AN/ARC-( ) SINCGARS																
AN/ARC-114 RADIO SET (REPLACES ARC-54)	X				X				X				X			
AN/ARC-( ) SINCGARS		X	X			X	X			X	X			X	X	
AN/ARC-115 RADIO SET	X				X				X				X			
AN/ARC-( ) SINCGARS																
AN/ARC-115A		X	X			X	X			X	X			X	X	
AN/ARC-116 RADIO SET (REPLACES ARC-73)	X	X	X		X	X	X		X	X	X		X	X	X	
AN/ARC-( ) SINCGARS		X				X				X				X		
AN/ARC-131 RADIO SET	X				X				X				X			
AN/ARC-(GARS) RADIO SET		X	X			X	X			X	X			X	X	
A U-21/149 SINGLE CHANNEL RETRANS (3)		X				X				X			X	X		
LOH/ARC-(GARS)			X				X				X				X	
ASC-15 (VHF VER OF C-1611 A/B, 7/C) W/ARC-114	X				X				X				X			
VIC-1 (INTERCOM CONTROL UNIT (ARMORED VEH)	X				X				X				X			
ASC-( ) GARS (UHF VER OF C-1611 A/B, 1/C)		X	X			X	X			X	X			X	X	
VIC-( ) GARS (1/C UNIT W/ARM VEH)		X	X			X	X			X	X			X	X	
AN/ARC-164 (REPLACEMENT FOR ARC-116)		X	X			X	X			X	X			X	X	
AN/PRC-70		X	X			X	X			X	X			X	X	
AN/PRC-104 (AN/VRC-169/AN/ARC-174)			X				X				X				X	
A - APPROVED FOR CANDIDATE ALPHA /NON-TOE ITEM																

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
SINGLE CHANNEL TRANS. FACILITIES (CONT.):																
SINCGARS/ECCM:																
AN/PRC-(GARS)E RADIO SET			X				X				X				X	
AN/VRC-(GARS)E RADIO SET			X				X				X				X	
AN/ARC-(GARS)E RADIO SET			X				X				X				X	
AN/ASC-(GARS)E RADIO SET			X				X				X				X	

	END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
		A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
	TELECOMMUNICATIONS PROCESSING FACILITIES:																
A	AN/FGC-25/26 TELETYPEWRITER SET					X				X							
	AN/GSQ-80 MESSAGE COMM CENTER					X	X	X	X	X	X	X	X	X	X	X	X
	AN/GSQ-(M) MESSAGE PROCESSING CENTER (FATT)						X				X		X		X	X	X
	AN/MGC-9 CENTRAL OFFICE TELETYPEWRITER													X			
	AN/MGC-17 TELETYPEWRITER CENTRAL OFFICE																
	AN/MGC-19 OPERATIONS CENTRAL									X				X			
	AN/MGC-22 TELETYPEWRITER TERMINAL									X				X			
	AN/MGC-23 TELETYPEWRITER RELAY CENTRAL													X			
	AN/MGC-32 TELETYPEWRITER CENTRAL OFFICE									X				X			
	AN/MGC-(S) DATA/TTY TERMINAL (SMALL)						X				X	X	X		X	X	X
	AN/MGC-(L) DATA/TTY TERMINAL (LARGE)						X				X	X	X		X	X	X
	AN/TGC-30 TELETYPEWRITER CENTRAL OFFICE					X				X				X			
	AN/TGC-40,41,42 TELETYPEWRITER CENTRAL OFFICE (FATT)						X	X	X		X	X	X		X	X	X
	AN/TSC-26 COMMUNICATIONS CENTRAL																
	AN/TSC-58 TELEGRAPH TERMINAL					X				X				X			
	TT 537/GT TELETYPEWRITER					X				X							
	AN/UGC-72 FATT TERM		X	X	X		X	X	X		X	X	X		X	X	X
	AN/UGC-73 FATT TERM		X	X	X		X	X	X		X	X	X		X	X	X
	AN/UGC-74 FATT TERM		X	X	X		X	X	X		X	X	X		X	X	X
	AN/UGC-75 FATT TERM		X	X	X		X	X	X		X	X	X		X	X	X
	A - APPROVED FOR CANDIDATE ALPHA /NON-TOE ITEM																

(14)

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
WIRE & CABLE:																
CX-162/G CABLE ASSEMBLY (5 PR. RUBBER COVER.)																
CX-163/G CABLE ASSEMBLY (5 PR. 12 FT. STU.)																
CX-1512 CABLE ASSEMBLY (SPIRAL-FOUR)																
CX-1606 TELEPHONE CABLE ASSEMBLY					X	X	X		X	X	X	X	X	X	X	X
CX-4245/G COAXIAL CABLE ASSEMBLY					X	X	X		X	X	X	X	X	X	X	X
CX-4566/G TELEPHONE CABLE ASSEMBLY					X	X	X		X	X	X	X	X	X	X	X
CX-4760 TELEPHONE CABLE ASSEMBLY					X	X	X		X	X	X	X	X	X	X	X
CX-7474 CABLE ASSEMBLY SPECIAL PURPOSE					X	X	X		X	X	X	X	X	X	X	X
CX-11230/G COAXIAL CABLE ASSEMBLY 100 FT.					X	X	X		X	X	X	X	X	X	X	X
CX-11230/G COAX CABLE ASSY 1/4 MI					X	X	X		X	X	X	X	X	X	X	X
WD-1/TT FIELD WIRE RL 159	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WD-1/TT DR-8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WD-1/TT MX-306	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WF-16 FIELD WIRE (4 WIRE)			X	X			X	X	X	X	X	X	X	X	X	X

	END ITEM - NUMBER & NOMENCLATURE	SEP BDE A	SEP BDE B	SEP BDE C	SEP BDE E	DIV A	DIV B	DIV C	DIV E	CORPS A	CORPS B	CORPS C	CORPS E	T. ARMY A	T. ARMY B	T. ARMY C	T. ARMY E
	TERMINAL EQUIPMENTS:																
	AN/GGC-3 TELETYPEWRITER SET	X				X				X				X			
A	AN/GXC-4 FACSIMILE																
	AN/GXC-(5) FACSIMILE					X	X	X		X	X			X	X	X	
	AN/PGC-1 TELETYPEWRITER SET	X				X				X				X			
	AN/TXC-1 FACSIMILE EQUIP.					X	X	X		X	X			X	X	X	
	AN/UXC-4 FACSIMILE, LIGHTWEIGHT, TAC, DIG											X	X			X	
	I/O DEVICES - ARTADS PECULIAR I & I/O DATA																
	TA-1 FIELD TELEPHONE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	TA-264 FIELD TELEPHONE SET	X				X				X				X			
	TA-312 FIELD TELEPHONE	X	X			X	X	X		X	X	X		X	X	X	X
A	TA-341 DTMF TELEPHONE (3290)		X				X			X	X	X	X	X	X	X	X
	TA-838 DTMF TELEPHONE (2W/4W) RUGGED		X				X				X				X		
A	TA-938 DTMF TP 2W COMMERCIAL									X	X	X	X	X	X		
	TP WECO (ROTARY)(TA-236)													X			
	COMPOSITION AND EDITING DISPLAY							X	X			X	X			X	X
	DSVT - DIGITAL SUBSCRIBER VOICE TERMINAL							X				X	X			X	X
A	DSTE (LOW SPEED) AUTODIN TERM **									X	X	X	X	X	X	X	X
A	DSTE (HIGH SPEED) AUTODIN TERM **									X	X	X	X	X	X	X	X
	SELECTIVE INTERCOM (TOC SWBD)(PBX SWBD)						X	X	X		X	X	X		X	X	
	DNVT - DIGITAL NON-SECURE VOICE TERMINAL							X				X	X			X	X
	DMD - DIGITAL MESSAGE DEVICE				X				X				X				
	A - APPROVED FOR CANDIDATE ALPHA /NON-TOE ITEM																
	** USACC FURNISHED																

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
COMMUNICATIONS SECURITY FACILITIES:																
TSEC/KG-13/HY-2															X	
TSEC/KG-27			X		X	X	X		X	X	X		X	X	X	
TSEC/KG-30/31													X	X	X	
TSEC/KL-7	X	X			X	X			X	X			X	X	X	
TSEC/KW-7	X	X			X	X			X	X			X	X	X	
TSEC/KWX-7	X	X			X	X			X	X			X	X	X	
TSEC/KY-8)	X				X				X				X			
TSEC/KY-28) NESTOR SERIES	X				X				X				X			
TSEC/KY-38)	X				X				X				X			
TSEC/KYK-28	X				X				X				X			
WIDE BAND SECURITY DEVICE (WBSD):		X				X				X				X	X	
KY-57/TSEC (VINSON)		X				X				X				X	X	
KYX-57 WIRE LINE ADAPTER		X				X				X				X	X	
TA-838 DTMF TELEPHONE (2W/4W)		X				X				X				X	X	
or																
TA-938 DTMF 2W TELEPHONE (COMMERCIAL)		X				X				X				X	X	
HYL-3/TSEC (P/O KY-28/38)	X				X				X				X			
TSEC/KG-81 (TED)			X	X			X	X			X	X				X
TSEC/KG-82/83 (KVG)			X	X			X	X			X	X				X
TSEC/KY-57 (VINSON)		X				X				X				X	X	
TSEC/KY-58 (VINSON)		X				X				X				X		
MX-9331/TSEC (REPLACES HYL-3)		X				X				X				X		

END ITEM - NUMBER & NOMENCLATURE	SEP BDE				DIV				CORPS				T. ARMY			
	A	B	C	E	A	B	C	E	A	B	C	E	A	B	C	E
COMMUNICATIONS SECURITY FACILITIES (CONT.):																
TSEC/KG-84 (DLED)			X	X			X	X			X	X				X
TSEC/KY-68 (DSVT)			X	X			X	X			X	X				X
TSEC/KY-65/75 PARKHILL		X				X				X				X		
KYK-13		X				X				X				X		
KYX-15		X				X				X				X		
KOI-18		X				X				X				X		
GREATER ROLE			X	X			X	X			X	X			X	X
VANDAL			X	X			X	X			X	X			X	X

APPENDIX D

CONCEPT ECHO REPRESENTATIVE

COMMUNICATIONS

MEANS

APPENDIX D

CONCEPT ECHO REPRESENTATIVE COMMUNICATIONS MEANS

This Appendix illustrates the integration of the various echelons described in Concept ECHO. Figure D-1 shows representative units and supporting communications means from Company to Theater. The primary points of interest are:

- o VHF/FM secure Cmd nets in the forward echelons.
- o DA TDMA TACSAT single channel RATT chain of command links.
- o MARTS Division sector coverage (including Corps units).
- o MARTS EAD applications (ACR, MSR control, Pershing Bn).
- o DA TDMA TACSAT multichannel terminal locations.
- o Integration of communications means (AVN GP to Airfield, Airfield to Inflight Plt).

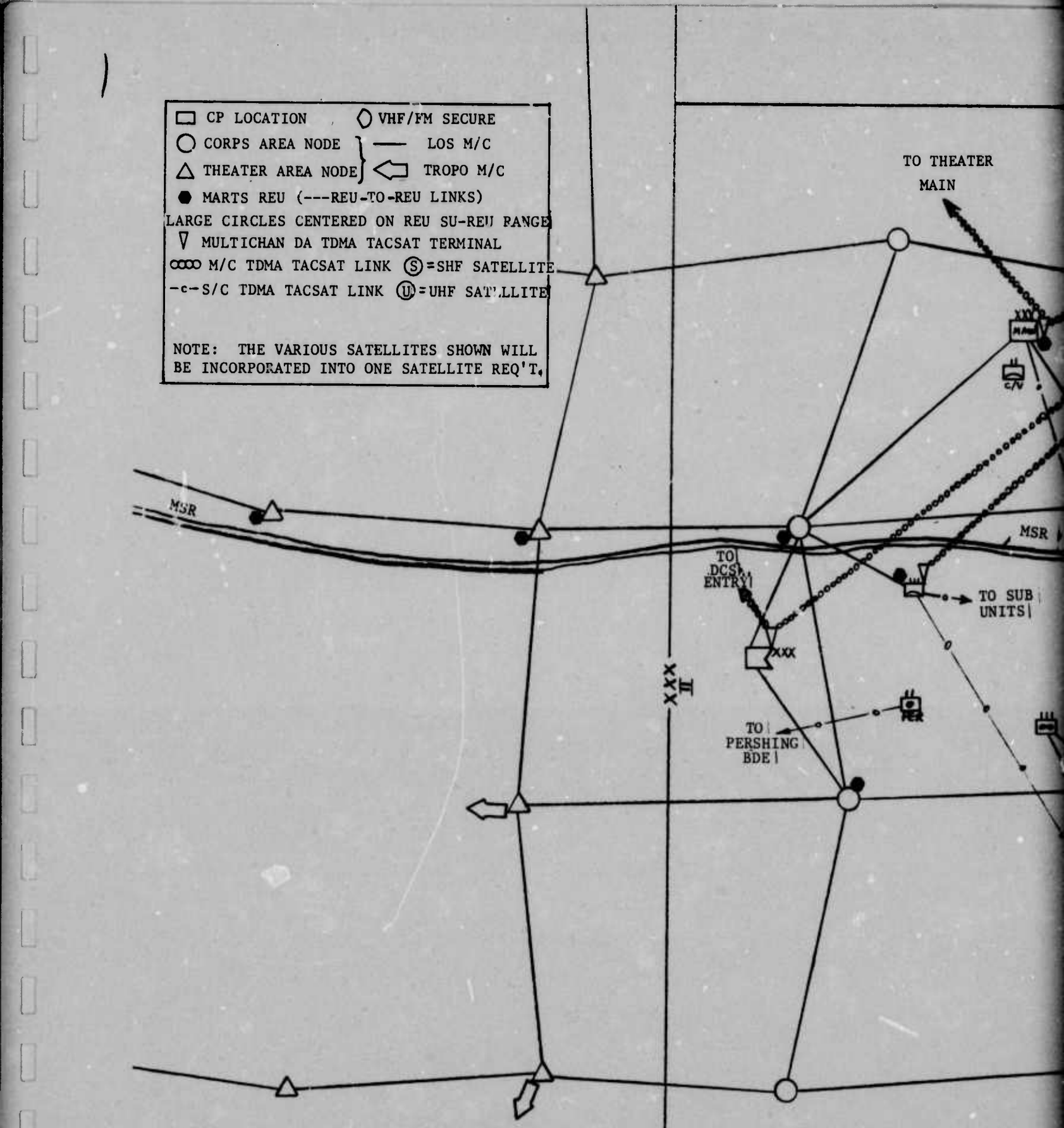
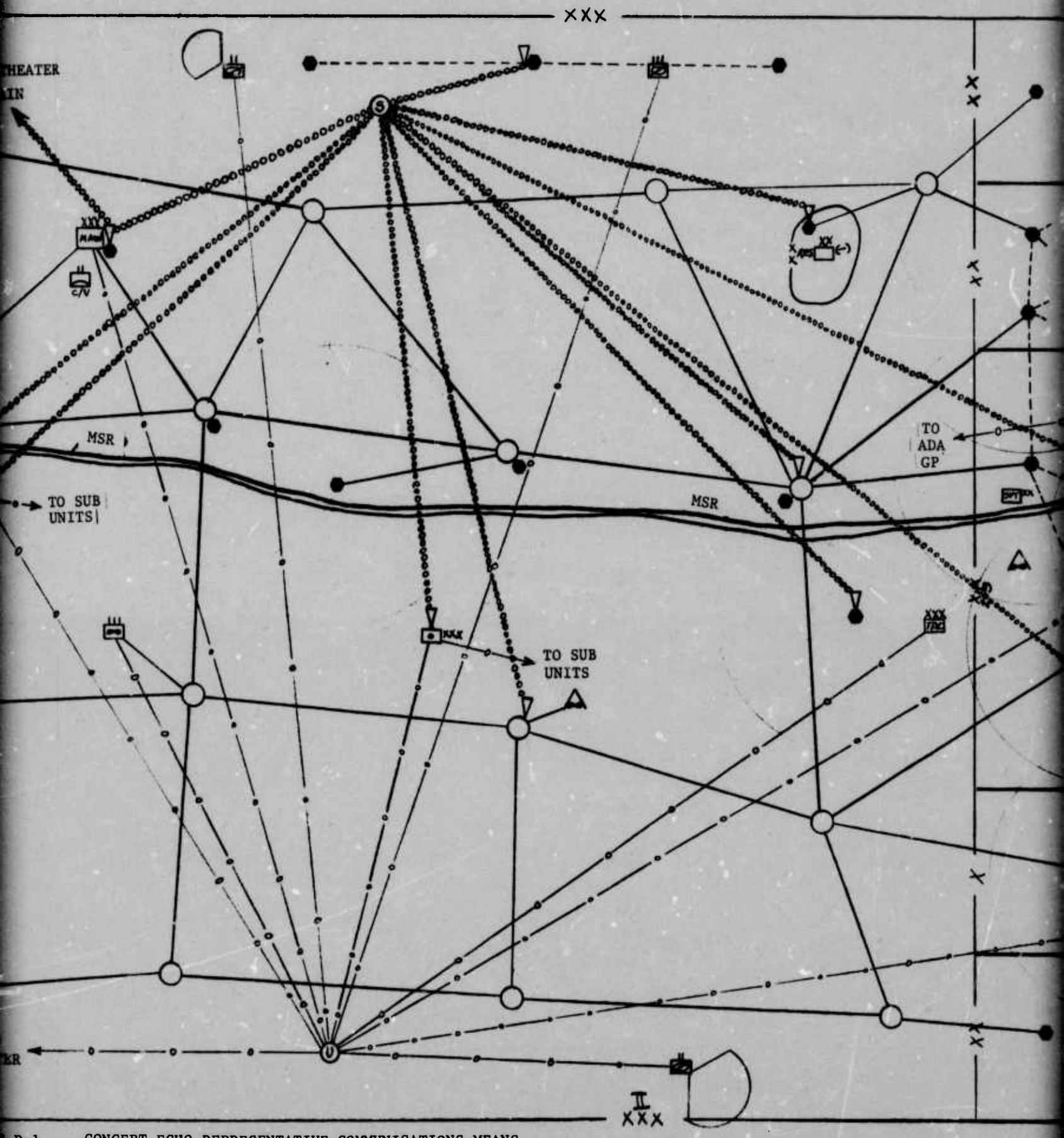
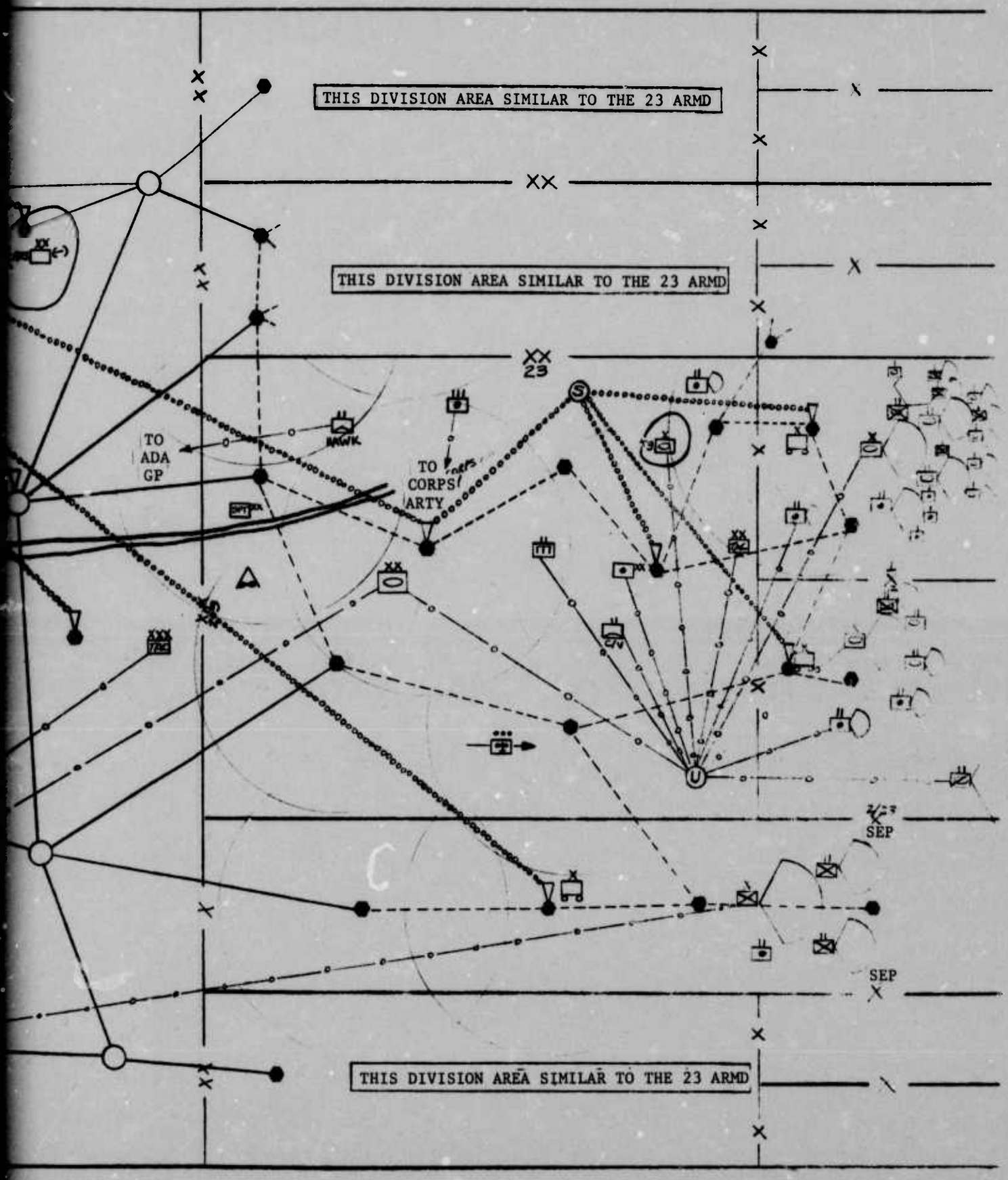


FIGURE D-1 CONCE



D-1 CONCEPT ECHO REPRESENTATIVE COMMUNICATIONS MEANS


THIS DIVISION AREA SIMILAR TO THE 23 ARMD
THIS DIVISION AREA SIMILAR TO THE 23 ARMD
XX
23
TO
ADA
GP
HAWK
TO
CORPS
ARTY
SEP
SEP
THIS DIVISION AREA SIMILAR TO THE 23 ARMD